POWER

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Ostracism as a Crime Deterrent

A YOUNG MAN wears smart clothes that are the envy of the swains and the admiration of the flappers of his circle.

What would be their attitude toward him if they knew that he picked them off at restaurants when their owners were not looking?

The principal deterrent, outside of inherent probity and self-respect, against this sort of thing is the disgrace, the loss of caste, the general contempt which follow inevitably upon exposure.

But what about the criminal who plays for bigger stakes?

How about the contractors who make public improvements costly by their manipulation of specifications, bids and contracts and conniving officials?

What about those who abuse the trust imposed upon them by the people and peddle the privileges and opportunities incident to their high office to their own financial gain?

What of the men who, with fabulous resources, prostitute those in places of responsibility, defy or pervert the courts, hang juries by bribery or coercion, delude or corrupt the electorate and buy their way into strategic official positions?

Do they incur the contempt and obloquy of the fellow citizens whom they have indirectly robbed?

Are they openly cut and sneered at and avoided by their neighbors and former associates? Did you ever hear of one who was expelled from his club, excommunicated from his church, held up to derision in his social circle or subjected to public reprobation by the organizations of the industry that he had brought into disrepute?

What shall it profit a man if he win the wealth of the Indies and lose the fellowship upon which the enjoyment of such wealth depends?

But there will always be a host of sycophants ready to justify or minimize his offense, to bask in the sunlight of his stolen affluence, and to annoint him with their purchased sympathy.

Men can no longer be scared into being honest by fear of future damnation, or men of large means by fear of the processes of law.

The best way to do it is to make high-hatted crookedness so damnably unfashionable that the act itself will defeat the preferment that it seeks.

Efficient Loading *of* Steam Turbines

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DIVISION of the load between the different units in a power station requires careful consideration by the operating engineer if the highest efficiency is to be obtained for the machine in service. Of equal importance is the selection of units to supply the load.

The economy of the units and their combinations may be studied from their water rates as discussed in the previous article "Large Economies Result from the Use of Steam-Turbine Loading Schedules," in the Sept. 27 issue. Table I shows the water rates of the four units on which the study was based, and Table II is a recapitulation of that study, and this article is an extension of the previous work.

TABLE I—WATER RATES OF UNITS

Unit	Size Kw.	½	¾	¾	Full
1	1,000	17.6	16.6	15.2	15.1
2	1,250	23.5 (312 kw)	18.0	16.5	16.2
3	2,000	17.2	16.2	14.8	14.7
4	3,000	16.7	15.7	14.4	14.3

Referring to Table II, which gives the steam consumption for single units and their combinations, it will be seen that for loads within its capacity unit No. 1 is the most efficient. For example, at a load of 750 kw. unit No. 1 requires 11,400 lb. of steam per hour, No. 2 unit, 12,900, No. 3 unit, 13,200, and No. 4 unit, 14,600 lb. per hour. At a load of 1,250 kw., the full-load rating of No. 2 unit, it has a higher water rate than No. 3 unit. These rates are 20,200 and 19,200 lb. per hour respectively. For a load from 1,250 to 1,750 kw. unit No. 3 is the most efficient machine, and from 2,000- to 3,000-kw. load No. 4 unit has the lowest steam rate.

The foregoing is for single-unit operation. Single units, where the load is within their capacity, are more efficient than any combination of two units. In general, for a given station load the water rate increases as the number of units in operation is increased.

For instance, consider a station load of 2,750 kw. As shown in Table II unit No. 4 will carry this load with a water rate of 14.2 lb. per kw.-hr., units Nos. 1 and 4 operating together will have a water rate of 14.7, units 1, 2 and 3 a water rate of 15.7 and all four units 17.6 lb. Evidently, the load should be carried with the minimum number of units and yet have a safe margin of capacity to care for fluctuations in station loads.

After the limit of capacity (3,000 kw.) for unit No. 4 is reached, a combination of two units must be used. From Table II the most efficient combination of two machines is units 1 and 4 for loads ranging from 3,000 to 3,750 kw. From 4,000 to 5,000 kw., units 3 and 4 give the most efficient combination of two machines that can carry these loads. Beyond 5,000 kw. the capacity of the two largest machines is exceeded and a combination of three machines must be used, which in this case is Nos. 1, 3 and 4, for loads from 5,000 to 6,000 kw. At the latter load the rating of the three machines is reached, and four units are required for loads from 5,000 to 7,250 kw. These loadings are indicated by the heavy lines.

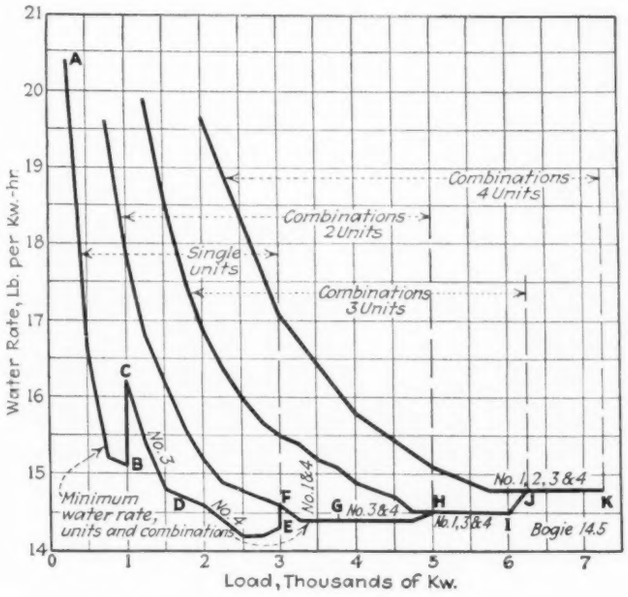
MINIMUM WATER RATE CURVES

These combinations of machine operation are shown on the curves in the figure. For loads of 250 kw. Table II shows unit No. 1 to be the most economical with a water rate of 20.4 lb. per kw.-hr., which is represented by point *A* on the single-units curve in the figure. This unit is also the most efficient for all loads up to 1,000 kw. At full load the water rate has dropped to 15.1 lb., which is point *B* on single-units curve.

If more load is to be carried than is within the limit of No. 1 unit, another machine must be put on the system. The most efficient machine for loads between 1,000 and 1,750 kw. is unit No. 3. For 1,000-kw. load it has a water rate of 16.2. Therefore, if unit No. 3 is put on the system and No. 1 taken off, at 1,000-kw. load, the water rate will increase from 15.1 to 16.2 and is represented by point *C* on the curve. Up to a load of 1,750 kw., No. 3 unit has the best water rate, decreasing to 14.7 lb. at the latter load and is represented by point *D* on the curve. At this point No. 4 unit is put on the system and No. 3 shut down.

No. 4 unit can take loads up to 3,000 kw. at which load it has a water rate of 14.3 lb. as indicated at point

E on the curve. Above 3,000 kw. two machines will be required. Table II shows the best combination to be units Nos. 1 and 4, which for a load of 3,000 kw. has a water rate of 14.6 lb., as represented by point F on the curves. At 3,250-kw load the water rate drops to 14.4



Minimum water-rate curves for the units and combinations of the units, Table I

and remains at this until between 4,750 and 5,000 kw. it increases to 14.5 pounds.

When the load increases beyond 3,750 kw., point G on the curves, units 3 and 4 make the most economical combination, having the same water rate at 4,000 kw. (14.4 lb.) as Nos. 1 and 4 have at 3,750 kw. When 5,000-kw. load is exceeded, at point H, three units are required and the best combination is units, 13 and 4 which has a water rate of 14.5 lb. up to a load of 6,000 kw., or point I on the curve. Between 6,000 and 6,250-kw. load, units 2, 3 and 4 will be required to carry the load and the water rate drops to 14.8 lb., point J on the curve. Beyond this point all four units are required, which have a flat water rate of 14.8 lb. up to full load of 7,250 kw. at point K.

Curve of Minimum Water Rates

From the foregoing it is evident that the curve $A\ C\ F\ H\ K$ is a curve of minimum water rates for the full range of load that can be carried on single units and their combinations. This loading is based on the assumption that each unit is loaded to or nearly to its full-load rating before additional capacity is put on the system. This is not done in practice, as a certain amount of reserve capacity must be maintained in service to take care of sudden change in load and other contingencies. Over a range of load from 1,000 to 7,250 kw. the average station water rate is about 14.5 lb., and this can be used at a bogie at the operators to work to, although every-day operation cannot be expected to reach this mark. These curves and the table also show to the operating engineer the amount of steam that can be saved by passing to a lower capacity combination of units as soon as load conditions will permit.

Steam may be saved in a number of ways: (1) By operation of the more efficient units or combinations; (2) by proper division of load among units; (3) by the assignment of load to the station when two or more stations are operating in parallel, where the units or combinations in operation will be operated at high efficiency;

TABLE II – TOTAL STEAM AND WATER RATES FOR DIFFERENT COMBINATIONS OF UNITS *

Station Load 1000 Kw.	Unit No.1		Unit No.2		Unit No.3		Unit No.4		Units 1&2		Units 1&3		Units 1&4		Units 2&3		Units 2&4		Units 3&4		Units 1,2&3		Units 1,2&4		Units 1,3&4		Units 2,3&4		Units 1,2,3&4	
	Total Steam	Water Rate	Total Steam	Water Rate	Total Steam	Water Rate	Total Steam	Water Rate	Total Steam	Water Rate	Total Steam	Water Rate	Total Steam	Water Rate	Total Steam	Water Rate	Total Steam	Water Rate	Total Steam	Water Rate	Total Steam	Water Rate	Total Steam	Water Rate	Total Steam	Water Rate	Total Steam	Water Rate	Total Steam	Water Rate
0.00																														
0.25	5.1	20.4	6.6		7.2		8.7																							
0.50	8.3	16.6	9.6		10.2		11.5		11.7	23.4	12.3		13.8		13.8		15.3		15.9											
0.75	11.4	15.2	12.9		13.2		14.6		14.7	19.6	15.3		16.6		16.8		18.1		18.7		18.9	25.2	20.4		21.0		22.5			
1.00	15.1	15.1	16.4	16.4	16.2	16.2	17.5	17.5	17.9	17.9	18.3	18.3	19.7	19.7	19.8	19.8	21.1	21.1	21.7	21.7	21.9	21.9	23.2	23.2	23.8	33.8	25.3	25.3	27.6	27.6
1.25			20.2		19.2	15.4	20.7		21.0	16.8	21.3		22.6		22.8		24.1		24.7		24.9	19.9	26.2		26.8		28.3		30.4	
1.50					22.2	14.8	23.5		24.3	16.2	24.3	16.2	25.8		25.8		27.1		27.7		27.9	18.6	29.2		29.8		31.3		33.4	
1.75					25.7	14.7	26.4		27.8		27.3	15.6	28.6		28.8		30.1		30.7		30.9	17.6	32.2		32.8		34.3		36.4	
2.00					29.4	14.7	29.3	14.6	31.5	15.7	30.5	15.2	31.5	15.7	31.8	15.9	33.0	16.5	33.6	16.8	33.9	16.9	35.2	17.6	35.8	17.9	37.3	18.6	39.4	19.7
2.25							32.4	14.4	35.3		33.6	14.9	34.4		35.1		35.9		36.5		36.9	16.4	38.1		38.7		40.2		42.4	
2.50							35.5	14.2			37.1	14.8	37.5		38.6		38.9		39.5		40.1	16.0	41.0		41.6		43.1		45.3	
2.75							39.0	14.2			40.8		40.6	14.7	42.1		42.0		42.5		43.2	15.7	44.0		44.6		46.1		48.2	
3.00							42.9	14.3			44.5	14.8	43.8	14.6	45.8	15.3	45.1	15.0	45.5	15.2	46.5	15.5	47.1	15.7	47.6	15.9	49.1	16.4	51.2	17.1
3.25													46.9	14.4	49.6		48.4		48.5		50.0	15.4	50.2		50.6		52.1		54.2	
3.50													50.4	14.4			51.9		51.5		53.5		53.4	15.2	53.6		55.1		57.2	
3.75													54.1	14.4			55.4		54.6		57.2		56.5	15.1	56.6		58.1		60.2	
4.00													58.0	14.5			59.2	14.8	57.7	14.4	60.9	15.2	59.8		59.7	14.9	61.1	15.3	63.2	15.8
4.25																	63.1		61.2	14.4	64.7		63.3		62.8	14.8	64.2		66.2	
4.50																			64.7	14.4			66.8		66.0	14.7	67.3		69.3	
4.75																			68.4	14.4			70.5		69.1	14.5	70.6		72.4	
5.00																			72.3	14.5			74.3	14.8	72.6	14.5	74.1	14.8	75.6	15.1
5.25																							78.2		76.1	14.5	77.6		78.7	15.0
5.50																									79.8	14.5	81.1		82.0	14.9
5.75																									83.5	14.5	84.8		85.5	14.8
6.00																									87.4	14.5	88.6		89.0	14.8
6.25																											92.5	14.8	92.5	14.8
6.50																													96.2	14.8
6.75																													99.9	14.8
7.00																													103.7	14.8
7.25																													107.6	14.8

* Steam, thousands of pounds per hour
Water rate, pounds of steam per kilowatt-hour

(4) by shutting down generators as soon as load conditions will permit; and (5) by power-factor correction, if necessary, so that units need not be held in operation due to the wattless current in the system requiring a higher capacity combination of units than would be necessary at a higher power factor.

The first three items follow from the previous discussion and study of Table II. The fourth point is more or less obvious, although its importance in steam saving is not always appreciated. A cautious engineer hesitates to reduce the plant capacity until he is sure the remaining units will be able to take the maximum swing in load that may come on them. Owing to this otherwise admirable failing, units are often kept on the line sometimes for hours after economy indicates they should be shut down. Study should be made of average load curves, considered with weather and other conditions that might affect load, to determine what margin in capacity is reasonable and justified. An unusually dark or stormy day, a circus in town, etc., can be readily provided for.

When Auxiliary Valve May Be Opened

Although it is an emergency measure, the auxiliary valves on the turbines may be opened if necessary, and operation for short periods at reduced efficiency might be justified in order to realize for longer periods of time the gain due to taking units off the line as promptly as possible. All this is a matter of judgment and must be governed by local conditions, although its importance cannot be too strongly emphasized.

Fortunate is the operator or engineer who has not had to deal with poor power factor, who has not had generator running for hours at near full load, and partly loaded prime movers with a load current too large to allow one machine to be shut down. It costs money to keep idle prime mover capacity in operation.

The effect of poor power factor on voltage distribution and heating of electrical equipment is outside the scope of this paper.

From the water rates of steam turbines, operating tables and schedules may be prepared which show (1) the relative economy of units and combinations and (2) the apportionment of load to units to obtain minimum steam consumption. It has been shown that minimum steam consumpiton with several units in operation at partial loads obtains when variations in station load are taken care of by picking up or dropping load on some particular unit or units in a definite manner, depending on the water rates of the units in the combination.

Steam may be wasted in considerable quantities by haphazard division of load among units as has been demonstrated. Units alone or in combination, suitable for the station load, should be selected for operation on the over-all water rates of the units or combinations. In general, units or combinations with lowest water rates for the range in load to be expected, should be started first and run longest.

Further economy can be obtained by careful observation of the average load conditions on the station, not only in the selection of units for operation for the various loads obtaining at different times of the day, but also in guarding against keeping more reserve generating equipment in service than is warranted by considerations of safely caring for the load and continuity of service. Injudicious selection of units and their loading easily entails losses of appreciable magnitude.

Savings in steam due to power-factor correction, where it would release units from service earlier, should be evaluated when considering the benefits of better power factor in distribution lines and the voltage regulation of the system.

What Do You Know?

By L. H. Morrison

The answers are on page 735

THE press has recently been filled with accounts of a so-called "thinking machine." Unfortunately, the age of robots has not arrived, for this machine does no thinking, but merely follows out the routine of adding and integrating along a determined course. Why an answer is obtained or even desired is not understandable to the tireless machine. But how well does this mechanical wonder typify many engineers? Do we know always, or even often, why we do think? Do we appreciate the governing laws and the limitations natural laws set to our engineering works? Are you but a "thinking machine"? See if you can answer the ten questions below; if so, you are entitled to a better name.

Ques. 1—Can cast iron be bent?

Ques. 2—One of the laws of physics says that if two gases are confined in a given vessel, the total absolute pressure in pounds per square inch will be the sum of the separate pressures exerted by each of the gases if it were alone in the vessel. Suppose you have a radiator filled with air at a pressure of 20 lb. abs. If steam at 5 lb. gage be permitted to flow into the radiator by the opening of the radiator valve, will the gage on the radiator indicate a total pressure of 40 lb. abs., or 25 lb. gage? If not, what will it register and why?

Ques. 3—In view of the answer to Question 2, at what temperature will water in a boiler boil if, before applying the fire, air is pumped into the boiler until the gage registers 10 lb. gage? The boiler stop valve is of course closed so the air cannot escape. In order to simplify the problem, assume that heating the water does not heat the air to cause its pressure to rise.

Ques. 4—Why does a uniflow engine show a markedly slipping steam line on low loads?

Ques. 5—All gases flow from a region of high to a region of low pressure. Is the draft, or pressure difference between the outside air and the chimney gases, greatest at the top or bottom of a chimney?

Ques. 6—Rapid steaming is a prominent characteristic of a water-tube boiler. Was this the reason for the invention of the first water-tube boilers?

Ques. 7—Is a steam meter as uniformly reliable in its readings when placed on a line to a reciprocating steam engine as when on a turbine line?

Ques. 8—What are the "foreign gases" so often found in the condensers of a refrigerating plant?

Ques. 9—When two alternators are operating in parallel, why is it impossible to regulate the load on each machine by varying their field excitation, as in the case of direct-current machines?

Ques. 10—Where does the air come from that causes a pump to become airbound?

Pulverized Coal Takes Fluctuations in a Stoker Fired Plant

THE combination of pulverized coal and stoker firing is one of the newer ways of obtaining more boiler output. Frequently, even if a boiler be capable of more capacity, the furnace arrangement is such that forcing is impossible. In the past this condition has necessitated the rebuilding of the entire furnace and increasing the stoker surface. The Dennison Manufacturing Co., Framingham, Mass., manufacturers of paper specialties, were confronted with this problem several months ago, and the solution arrived at involved the application of pulverized coal burners in combination with the existing stoker equipment.

The power plant of this firm was constructed in 1912 and consisted of four 2,500-sq.ft. Wickes water-tube boilers together with two duplex and one single-cylinder Corliss engine direct-connected to direct-current generators.

At that time hand firing was the prevailing method in New England, but after discussion among the engineers designing the plant, it was decided to install side-feed stokers, using the furnace arch illustrated in Fig. 4. These four boilers were set in units of two each and successfully carried the load for a number of years, two of the boilers being as a rule held in reserve.

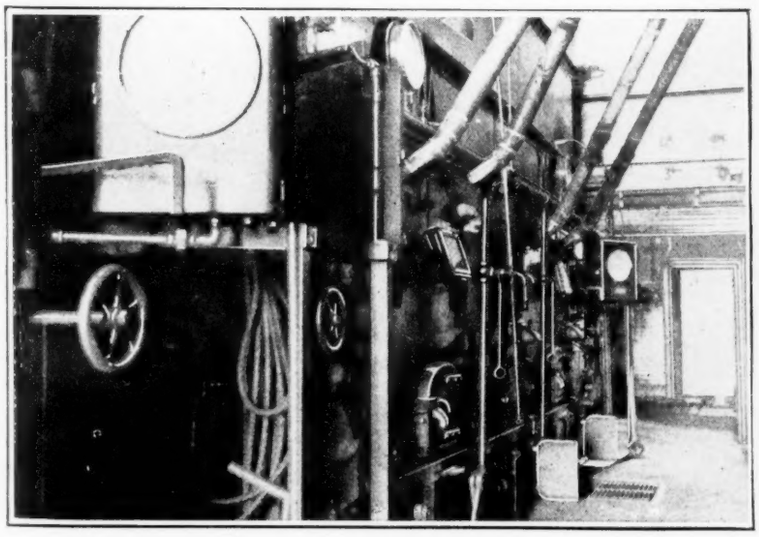
Increased production in the factory had to be met by an increase in the steam output. The steam demand was not uniform, and the debatable question was whether three boilers should be put in service or two forced to an over-rating. As the variable load meant that for much of the time the three would be much under load, it was evident that the average efficiency would be low. On the other hand, the furnace setting and the stoker arrangement prevented overloads being carried on two boilers without a marked decrease in the evaporation rate per pound of coal.

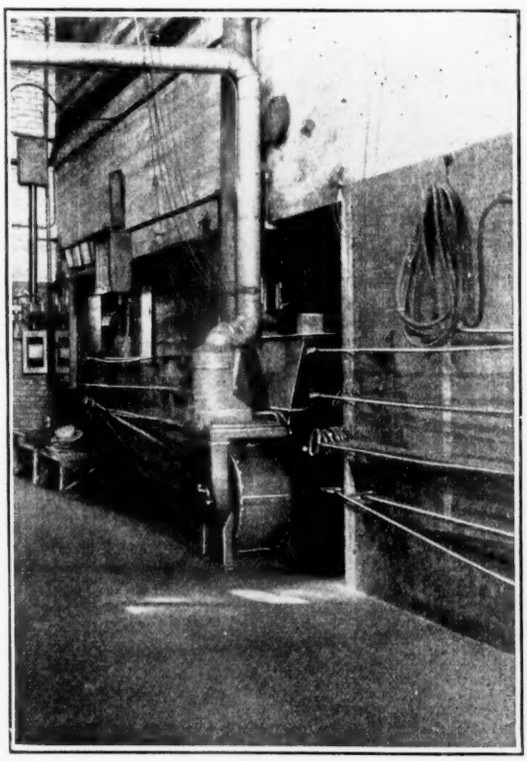
At this point the feasibility of using pulverized coal in conjunction with the stoker was investigated. It was found that, while most of the pulverized coal equipment on the market involved an initial investment not commensurate with the limited duty to be imposed, it was possible to install a small-capacity pulverizer at a machine cost of approximately $1,500 each. One of these machines is shown in Fig. 2. This apparatus could be made automatic in action so that it would deliver the powdered coal into the furnace only at those times when the stoker was unable to hold the steam pressure to its normal value.

To accommodate the two pulverizers, each of which serves two boilers, recesses were made in the boiler room wall and under the coal hoppers, as shown in Fig. 2. In this way the coal flows to the hopper of the pulverizer

Fig. 1 (Below)—Entrance of pulverized coal feed to the furnaces

Fig. 2—(Right)—The pulverizers are placed under the coal bins





without handling. The powdered fuel enters the furnaces through nozzles at the ends of four conduits which branch off from the main coal delivery pipe. The arrangement is shown in Fig. 1.

The electrical control switch is adjusted so that the pulverizer starts up and begins to deliver coal into the

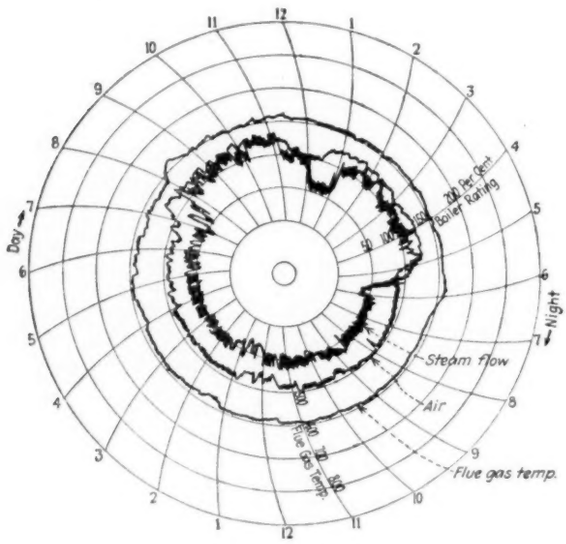


Fig. 3—Variation in the boiler operation

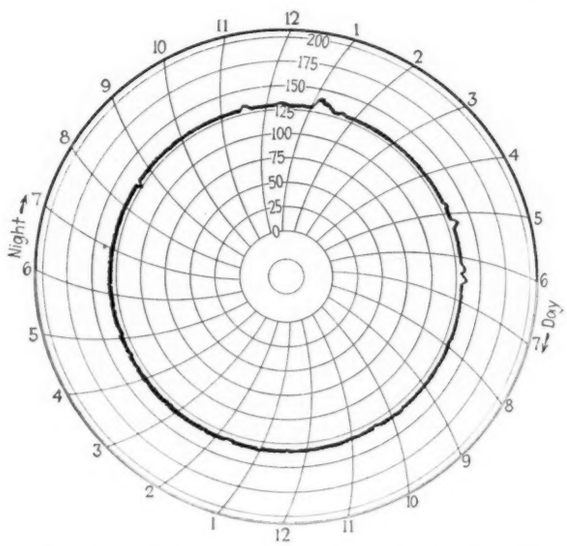


Fig. 5—The steam pressure is kept uniform

furnace whenever the steam pressure drops four pounds, and the machine stops as soon as the pressure builds up again. The fireman carries the coal on the stoker grates at a fixed depth, so that its rate of coal burning is approximately constant, and the variation in combustion is controlled by the pulverizer's action. In Fig. 3 is shown a chart from the steam-flow air-flow meter. It

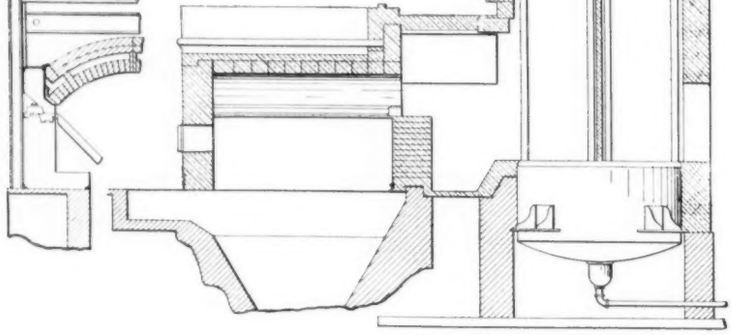


Fig. 4—Layout of former boiler setting

will be noticed that the steam and air lines are not so close together as is usual in boiler operation. This is due, of course, to the operation of the pulverizer, which increases the steam flow and combustion rate, while the air pressure drop through the stoker bed remains constant. In other words, when the pulverizer is not operating, the air-flow steam-flow ratio is high and the air and steam lines are far apart. Since the air entering with the

pulverized coal is less than needed for its total combustion, the missing quantity is obtained from the excess air entering through the stoker bed. In spite of this the evaporation rate does not appear to be affected by the decrease in air to coal ratio.

While the chart shows an average steam output but little more than 100 per cent during the day shift and 50 per cent during the night, this does not represent the usual conditions. Attention is called to the flue-gas temperature curve, which indicates that even though the pulverizer is cutting in and out at short intervals, only slight changes occur in the flue-gas temperature.

After a short period of operation it was found that

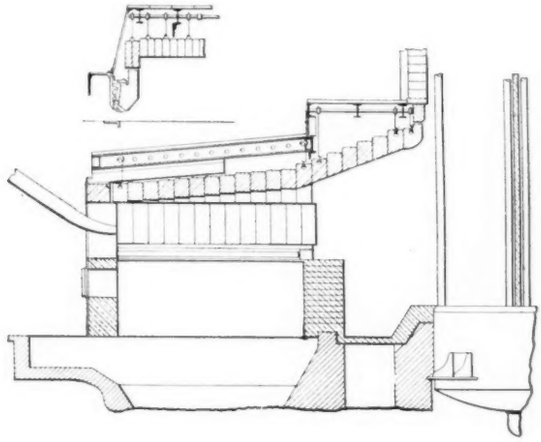


Fig. 6—New arch construction

the furnace walls would not stand up under forced combustion conditions, and as a consequence the furnaces of two boilers were altered as shown in Fig. 6. The larger throat opening at the boiler served to reduce the refractory destruction, and the other two units will be altered in like manner.

The coal as it is received contains considerable moisture, and some little difficulty was encountered in grind-

ing it fine enough. To dry the coal the air intake of the pulverizer blower was extended by a galvanized pipe, shown above the pulverizer in Fig. 2, so that heated air is taken from over the dutch-oven tops of the furnaces. This eliminated all the difficulty, and at present 80 per cent of the powdered coal will pass through a 100-mesh screen.

When the pulverizer comes into operation, a small part of the pulverized coal entering the furnace apparently reaches the stoker-fired bed, but practically all is burned in suspension. The color of the chimney gases does not change when the pulverizer is in operation. The closeness with which the pulverizer meets the variation in steam demand may be deduced from an examination of the recording pressure-gage chart shown in Fig. 5.

Answers to What Do You Know

The questions are on page 732

Ans. 1—In the popular opinion bending means a more or less rapid distortion of a piece of material. In this sense cast iron cannot be bent. However, if pressure be exerted slowly, cast iron can be distorted to take a permanent set.

Ans. 2—The law is true only for perfect gases, but is approximately correct in case of air and a vapor such as steam. Nevertheless, the gage will register but 5 lb. gage, or 20 lb. abs. This is for the reason that the opening of the radiator valve causes the vessel under consideration to include the entire heating system. The water temperature in the boiler is such that, neglecting any slight frictional drop, the steam pressure in the system is 20 lb. abs. The air is trapped in the upper part of the radiator and has no opportunity to fill the entire system, so it changes its volume just enough to cause its pressure to equal that of the steam. If it were possible for the air in the radiator to fill the entire system, its pressure after this expansion would be so insignificant as not to show on the gage, the pressure will still be approximately the steam pressure.

Ans. 3—Boiling differs from surface evaporation in that in the former a rapid ebullition takes place, the steam rising through the water in bubbles. Under these circumstances no boiling takes place under the conditions outlined. While the water is warming, surface evaporation is constantly taking place and at all times the vapor pressure of the steam is that corresponding to the existing water temperature. The steam molecules rise from the surface of the water to fly about the space over the water independently of the existence of the air, but the formation of steam occurs only at the surface and no boiling or ebullition takes place until the stop valve is open, whereupon the steam molecules flow out into the line along with some of the air, and boiling occurs. With the stop valve closed, the gage will register the sum of the pressure exerted by the air and by the steam, which latter is the saturated vapor pressure for the existing water temperature. This condition is often noticed in boilers which, when first fired, may show, say, 10 lb. gage, but the needle will drop back to zero when the stop valve is opened, although the mass of water in the boiler is ample to give off a large amount of steam without a noticeable pressure drop.

Ans. 4—Uniflow engines use a fairly steep cam to raise the poppet valves. On full load the valve roller moves up the cam slope and is on the flat portion during most of the admission period. The valve is full open during this time and little wiredrawing occurs. On light loads the roller is always on the slope of the cam, and as the valve is only partly open, wiredrawing takes place.

Ans. 5—At the bottom. At the top the exterior and interior gas or air pressure are the same or nearly so. At the bottom the gas pressure inside is less than the outside air pressure. But it must be remembered that the air at the base has a greater pressure than the air at a level with the chimney top. Consequently, the actual absolute pressure of the gas at the base is greater than at the top and the gas flows upward.

Ans. 6—Fire-tube boilers were made of wrought-iron plates at that time and could not carry much pressure with safety. In order to reduce the water mass and to make a boiler of smaller and stronger component parts, designers constructed water-tube units.

Ans. 7—No. The pulsations in the steam flow to the reciprocating engine tend to cause the meter to read incorrectly.

Ans. 8—Mostly air that has leaked in along the compressor rod.

Ans. 9—The only way to control the load distribution between two alternating-current generators operating in parallel, is to adjust the governor as if to vary the speed of the prime mover, for any attempt to raise the voltage on one machine by increasing its excitation will simply set up a circulating wattless current between the two machines, which will weaken the field in the overexcited machine and strengthen it in the other, resulting in a slight increase in the line voltage, but practically no change in the load distribution.

Ans. 10—Under atmospheric conditions water contains about 2 per cent air in solution. When subjected to less pressure, the air expands, and when given sufficient time, as while the water is flowing through a long suction pipe, the air becomes liberated from the water, usually in the form of collections of small bubbles that adhere to the pipe or pump surfaces, or the air gathers in pockets of the pump spaces. The trouble can be prevented by increasing the head of the suction supply and by running the pump slower, so the pump cylinder will be filled with less reduction of pressure of the suction water.

A Five per Cent Decrease in Volts at a tungsten lamp's terminals will decrease the watts input about 8 per cent, the candlepower will decrease about 17 per cent and its normal life will be increased over 100 per cent. An increase of 5 per cent in voltage will increase the wattage consumption of the lamp 8 per cent and the candlepower 19 per cent, but its life will be reduced to less than 50 per cent. Although doubling the cost of lamps might not be a serious item to obtain more light in some cases, there are other factors, such as blacking of the bulbs and excess illumination, that would make it undesirable to operate lamps at excess voltage. If a lighting system is properly designed, installed and maintained, the best service will be obtained from lamps operating at rated voltage.

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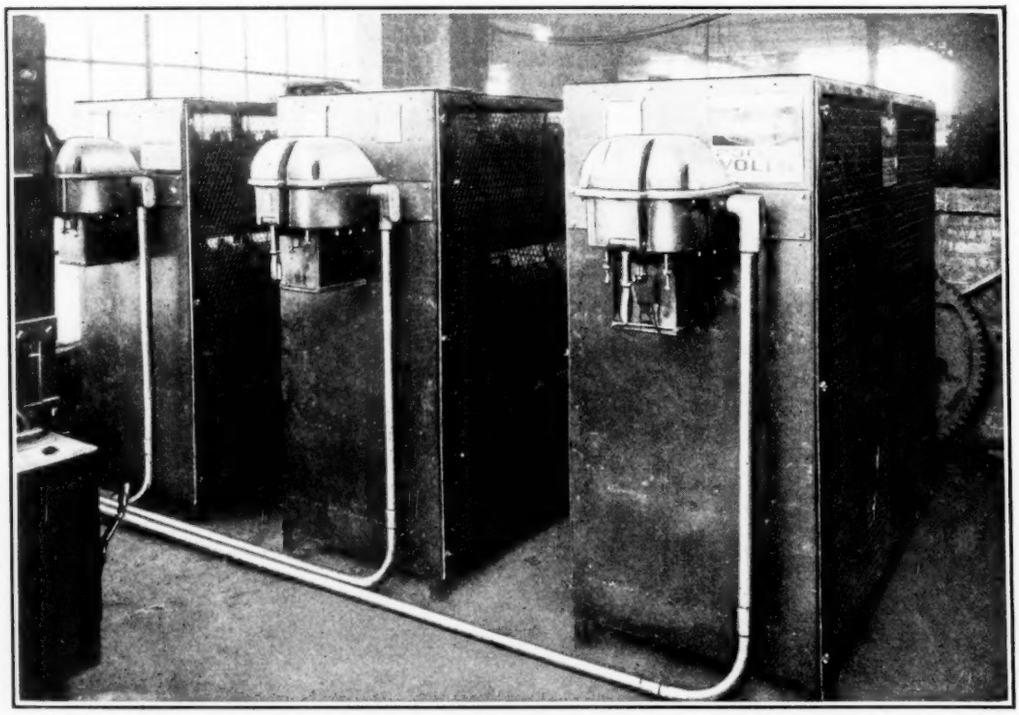

Static condenser installation rated at 300 kva. and 2,300 volts

Correcting Power Factor With Static Condensers
Reduces Power Costs

By J. E. TROSTLE
Supply Engineer, Westinghouse Electric & Manufacturing Co.

AN OUTSTANDING opportunity for economic improvement in the electrical industry is the correction of power factor. Low power factor prevents full use of the generating and distribution system and increases the resistance losses per unit of energy delivered to the utilization devices. In the United States there is a large excess in line losses due to wattless current. In addition there is an excessive investment in power and distribution equipment on account of the lower power factor of power systems.

By the addition of a static condenser to improve power factor, certain power companies and industrial plants have been able to carry their regular load with less equipment in operation, while others have made it possible to take on more load without purchasing additional generating equipment.

Assume a 2,300-volt distribution line or feeder which will handle a maximum of 1,000 kva. At 75 per cent power factor this feeder will handle only 750 kw. If the power factor is increased to 90 per cent this feeder will be able to carry an additional 150 kw. Besides increasing the kilowatt capacity of the feeder, the transmission losses per kilowatt will be reduced, and inasmuch as the current handled by the line is less, better voltage regulation will be secured.

In many cases the benefit derived does not warrant the increase of the power factor to 100 per cent, on account of the increasing cost of corrective equipment for

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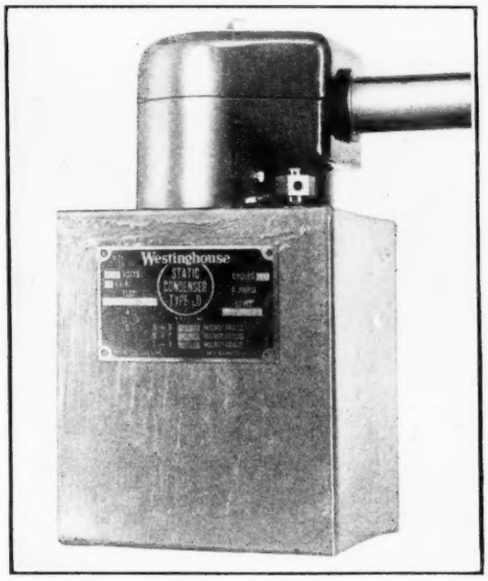
the higher power factor. Usually, it pays to raise the power factor to 85 per cent, while in many cases correction to 90 or 95 per cent is warranted. This depends on local conditions and the value of correction to the power company or industrial plant.

Frequently, the wattless current due to low power factor causes low voltage at the load end of the line, in which case the addition of a static condenser at the load will improve voltage regulation by eliminating the wattless current in the line. In many cases the voltage has been increased 10 per cent or more. This increase in voltage is desirable when using induction motors. The pull-out and starting torques of induction motors increase as the square of the ratio of the voltages, and the horsepower will increase somewhat with an increase of voltage depending on the distribution of losses in the motor.

kilovolt-amperes at the right phase relation with the power, but these work out best in the case of large installations. Synchronous motors may be manipulated so as to operate partly as synchronous condensers. This type of motor provides low-cost correction, but is limited to cases where it is applicable.

Static condensers store energy at the right phase relation to counterbalance the wattless current taken by the motor fields. This provides a convenient means of obtaining good power factor without introducing other problems; that is, the condenser takes practically no energy and corrects the power factor. The static condenser therefore is highly efficient.

When the stored electromagnetic energy as in the fields of motors is exactly equal to the stored electrostatic energy as in the static condenser, the power factor becomes unity. When there is an excess of electromagnetic energy the power factor becomes lagging, and leading in the case of excess electrostatic energy.



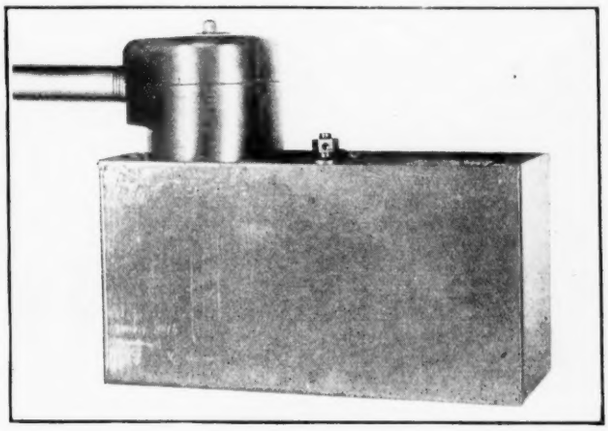


Fig. 1—Three-phase 220-volt one-kva. condenser for individual motor correction

Fig. 2—Three-phase 220-volt 2½-kva. condenser for individual motor correction

The various advantages of power-factor correction may be listed as follows:

1. Decreased losses in generators, exciters, distribution lines, transformers and in the consumer's plant. A system working at unity power factor would have one-half the copper losses of one working at 70 per cent power factor.

2. In addition to better voltage regulation the line voltage will be increased slightly if it was previously low due to poor regulation.

3. Saving, due to elimination of rate penalties for operating at low power factor.

Power factor may be raised to or near unity in two ways, either by eliminating the reactive current or by introducing leading reactive current to counterbalance this current. The reactive current may be reduced sometimes by replacing motors with ones having a higher power factor, but usually it is necessary to supply a leading current to the load.

Synchronous condensers may be floated across the line and operated in such a way as to supply the magnetizing

When proper proportions of magnetic fields and static fields are operated in parallel, there follows a continual transfer of magnetic and electrostatic energy from one to the other. The magnetic field supplies the energy for the static condenser, while the static condenser supplies the energy to build up the magnetic field.

Static condensers for two- or three-phase service are available for individual motors for connection directly across the motor terminals. The two- and three-phase units are arranged for conduit connection. Three-phase units are delta connected internally, whereas two-phase units have four terminals, two for each phase. These units are available in sizes of ½ to 5 kva. for 220, 440 and 550 volts (see Figs. 1 and 2).

Static condensers are also available for group correction or for connection on large feeders in sizes from 30 to 300 kva. and for voltages of 220 to 5,000 at 60 cycles. In cases where more than 300 kva. is required, more than

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one outfit can be used. When used on 25 cycles, the kilovolt-ampere capacity is reduced in proportion.

Condensers are usually equipped with circuit breakers for switching them off and on the line. The type of breakers varies depending on the location of the equipment and the line to which the condenser is to be connected.

One of the objects of this article is to call attention to some cases where power-factor correction has been carried out. What has been done in these plants could be done in many others where rate systems are in effect that take into account power factor.

The Cone Automatic Machinery Co., manufacturer of lathes, milling machines, automatic machines and other machine-shop equipment, uses a large number of 5- to 50-hp. squirrel-cage motors and employs both group and individual drive.

At first this company did not feel that it would be necessary to install a static condenser. However, after a few months' operation under new power-factor rates, it appeared to be a profitable investment. The enforcement of the rates was withheld, however, during the few months while the purchase of the condenser was being considered. The rate system applied is as follows:

One mill per kw.-hr., penalty or surcharge from 70 per cent to 85 per cent power factor.

Four mills per kw.-hr., penalty or surcharge below 70 per cent power factor.

One mill per kw.-hr. rebate above 95 per cent power-factor.

This company installed a 120-kva. three-phase sixty-cycle outdoor type condenser. In the table is shown the condition existing before the rates were enforced and the saving after the installation of the condenser.

Month		Kw.-Hr.	Power Factor	Penalty Avoided	Rebate Received	Total Saved
January,	1926	47,040	68	No condenser	No condenser	0
February,	1926	55,920	72	No condenser	No condenser	0
March,	1926	43,440	66	No condenser	No condenser	0
April,	1926	45,840	66	No condenser	No condenser	0
May,	1926	35,280	65	No condenser	No condenser	0
June,	1926	33,000	64	No condenser	No condenser	0
July,	1926	29,040	88	Condenser installed		0
August,	1926	31,800	97	127.20	31.80	159.00
September,	1926	31,440	97	125.76	31.44	157.20
October,	1926	35,400	96	141.60	35.40	177.00
November,	1926	34,920	96	139.68	34.92	174.60
December,	1926	37,080	96	148.32	37.08	185.40
January,	1927	41,040	97	164.16	41.04	205.20
February,	1927	37,680	96	150.72	37.68	188.40
March,	1927	27,120	97	108.48	27.12	135.60

Initial cost of static condenser	$2,117.00
Installation cost	100.00
Total first cost	$2,217.00
Interest, depreciation, etc., per year at 15 per cent	332.55

Cost to operate the condenser per year

$$\frac{3.5 \times 120 \times 30 \times 24}{1,000} = 302.4 \text{ kw.-hr. per month}$$

$$302.4 \times 12 \times 0.03 = \$108.86$$

Average penalty	$138.24
Average rebate	34.56
Total	$172.80 per month
Saving	$2,073.60 per year

Net return $2,073.60 — $108.86 = $1,964.74 per year, or 88.65 per cent pear year to cover interest, depreciation, etc.

These figures for operating cost of the condenser are based on 30 days per month of 24 hours per day, as it has been found that practically all condensers are left on the line continuously.

The average losses for oil condensers are 3.5 watts per kilovolt-ampere. The penalty and rebate are the average of eight months.

The power load of the Fairbanks Scale Co. is composed of various kinds of machine tools used in the manufacture of scales, and several small electric furnaces. The motors used are all of the squirrel-cage type with standard control, with the exception of one, which is a 50-hp. synchronous machine.

The penalty in the rate was 0.011c. per kw.-hr. for each degree of power factor below 80 per cent and no rebate allowed above 80 per cent power factor. A 240-kva. condenser was installed on the 2,300-volt line.

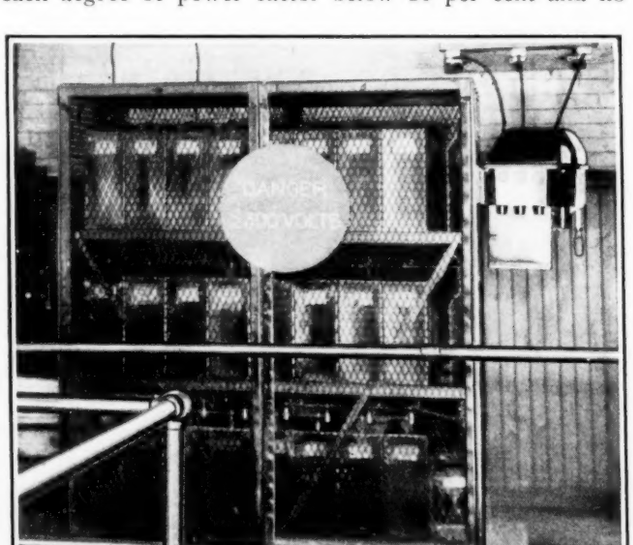

Fig. 3—Static condenser rated at 240 kva., 2,300 volts

The average power factor for the eight months previous to installing the condenser was 67 per cent, whereas it was over 85 per cent after the installation. Assuming the power factor would have continued to average 67 per cent if the condenser were not installed, the customer would have had to pay an average surcharge of $299.16 per month on the power bill.

Initial cost of static condenser	$3,596.00
Installation of static condenser	100.00
Total first cost	$3,696.00
Interest, depreciation, etc., per year	$554.40

Cost to operate condenser per year

$$\frac{3.5 \times 240 \times 30 \times 24}{1,000} = 604.8 \text{ kw.-hr. per month}$$

$$604.8 \times 12 \times 0.02 = \$145.15$$

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Average penalty equals $299.16 per month, or $3,589.92 per year.

Net return = $3,589.92 — $145.15 = $3,444.77 per year, or 93.4 per cent to cover interest, depreciation, etc.

The American Welding Co. doing butt-welding work, buys its power at 23,000 volts, and steps it down to 2,200 through the power companies' transformers to the static condenser. It is then reduced to 440 volts for welding machines, 220 volts for motors and 110 volts for the lighting load. The load consists chiefly of butt-welding machines and squirrel-cage motors equipped with auto-transformer type starters. About 75 per cent of the load consists of butt welders, which have a very intermittent load cycle, drawing power at the rate of from 5 to 10 kw. over periods varying from 10 to 30 sec. depending on the cross-section of the material being welded. The power factor of these welding machines is approximately 50 per cent.

This company was advised of the rate situation regarding power factor and asked by the power company to take steps to correct the power factor, and a 300-kva. static condenser was installed. The power factor of the load before the installation was 55 per cent, whereas it was increased to 85 per cent by the condenser.

Installing the static condenser saved approximately 148-kw. billing demand at $1.80, or $268 per month. This initial cost of the condenser was $5,500. It was installed in February, 1924, since which time there has been no call for service in connection with this equipment, which required approximately 19 months' saving to pay for itself.

The only maintenance charge to keep a condenser in good operating condition is to dust or wipe off the tops of the units occasionally. If a condenser is in a place where large quantities of dust collect on the units, it will be necessary to dust or wipe off the units quite frequently.

The headpiece shows the American Welding Company's static-condenser installation. Owing to developments since this installation was made, the same kilovolt-amperes of condenser capacity will now occupy about half the space. While there are many other cases of correction as profitable or more so than those mentioned, correction is often made for other reasons, where the saving is equally important but not so readily evaluated.

Careful analysis from the points of view of immediate returns in the forms of rates and operation, generally shows that correction in one form or another is practically always justified.

Bending Copper Tubing

IN ANSWER to R. C. Martin's inquiry on bending copper tubing made in October 18th issue, I find that the best results are obtained when using a quadrant type of hickey, or with one of the patented bending machines, which use a different size quadrant for each size of pipe. My experience has been with pipe sizes ranging from $\frac{1}{4}$ to 3 in. diameter.

For sizes up to one inch the tubing may be bent by hand with a quadrant-type hickey, but with the larger size the machine is to be preferred. I have found that it is not necessary to heat the tube to make a good bending job. Of course, care must be exercised not to make the bend on too short a radius.

To prevent the tubing from being buckled during the bending process, it is the practice of some workmen to fill it with resin or sealing wax. One end of the pipe is closed with a wooden stopper and the molten resin or wax is poured in the other end. When the filler has had time to harden, the tubing is bent, after which the resin or wax is removed by heating the tube.

With large tubes fairly good results have been obtained by using fine sand as a filler and closing each end of the tube with a wooden plug to keep the sand in place. In some cases resin has been poured into the ends of the pipe to retain the sand.

If the tube is heated before bending and after filling with sand, the sand must be dry or the tubing may burst owing to the steam pressure developed from evaporating the moisture in the sand. The heating may be done with a gasoline torch played on the pipe along the section where the bend is to be made. If there is a seam in the tubing, it should be placed so as to be on the inside of the bend.

L. H. KIPP.

Hamilton, Ohio.

DISCUSSING R. C. Martin's question on "Bending Copper Tubing," I would like to call attention to my experience in making installations of copper tubing in engine rooms. Copper tubing should be carefully heated over a charcoal fire and let cool slowly before attempting to bend it. After the heating and cooling treatment has been completed, plug one end and fill the section to be bent with molten rosin. When the rosin has cooled the tube can be bent almost any shape without buckling or opening at the seams. If the tube is to be cut and threaded, this also can best be done while filled with rosin.

When emptying the tube, begin heating it at one end over a charcoal fire, and move the tube over the fire as the rosin drops into the melting pot. The rosin may be used over again any number of times. By following the practice described, a number of good copper-tubing jobs were made with tubes ranging in size from one-quarter to four inches diameter. This work was performed without a single tube failure by opening at the seams.

AXEL LEKSTROM.

Ironton, Minn.

A METHOD that I have successfully used for bending copper tubing for electrical work is to fill the tube with molten rosin. Allow the rosin to cool and harden. Then bend the pipe and it will not kink. Almost anything that will solidify will serve the purpose. Lead is sometimes used.

After the bending is completed the rosin or lead is melted away.

Regarding keeping the seams from opening, keep the seam on the "inside" if possible so that it will be in compression. However, there is no way of assuring that seams will not open if they are not well made.

Newark, N. J. W. F. SCHAPHORST

REFRIGERATION *for the Engineer*

A Ton of Ice for Less Than Forty Kilowatt-Hours

By F. P. Mac Neil

THE palm for manufacturing ice at the lowest power consumption seems to be due the Fulton Ice Company, Cherry Street, in the lower east side of New York City. This plant uses less than 40 kw.-hr. per ton of ice over a wide range of output and has an actual kilowatt-hour consumption practically equal to the maximum demand. The plant has a rated capacity of 168 tons, but in summer manufactures 200 tons, dropping down to a low figure in the winter.

AMONG the factors that contribute largely to the successful construction and operation of a profitable ice plant, there are three that are prominent because of their importance. The first of these is that the owners of the plant be fortunate in engineering talent selected to design the plant. The second factor is that the firms supplying the equipment place quality ahead of monetary considerations. The third factor is that the owners be able to secure the services of a first-class operating engineer.

That these factors seriously influence one another can be seen when we consider that even if the equipment furnished be of the best and the operating engineer good, the plant may suffer tremendously in competition with others of the same capacity, owing to the designers adhering to hide-bound traditions concerning refrigeration.

A schematic drawing, Fig. 2, shows the layout of the plant, and the course of the ammonia may be traced. Much of the piping has been omitted from the plan, as it would render the whole too complex to be easily comprehended. While the layout has been kept as close as possible to the actual position of the various members, the ice-tank coil has to be shown out of relative proportion and its location changed to the engine room to make the drawing compact. The direct reasons why this plant can produce ice at so low a power cost are that it is designed, after careful analysis of the trade demands, to operate with high efficiency at three different points of capacity, namely, 200 tons, 145 tons and 45 tons. The plant auxiliaries have been selected so machines of the proper size are available for different rates of capacity. A large machine does not have to be put on a small job, but a machine of the proper size is made available through the various combinations that may be effected. This may mean a little extra first cost, but extra first cost and its accrued interest are more than wiped out by the great gain in economy.

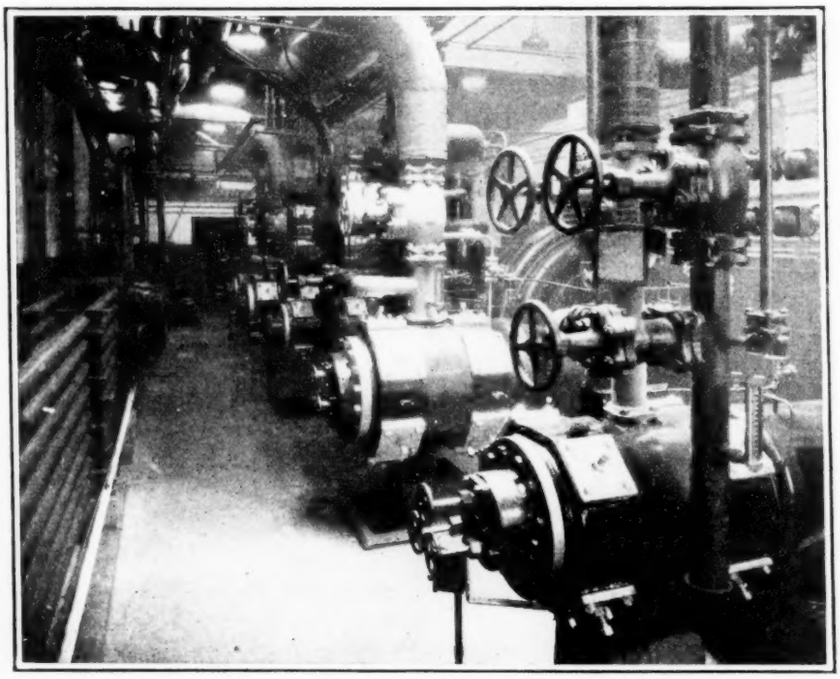

Fig. 1—The two-stage clearance-pocket compressors

The selection of sizes and capacities of compressors is such that the machines are

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running at their highest efficiencies all the time. Nothing that can improve efficiency is left without careful consideration by the designers and by the operating staff.

The policy of the owners is one of liberality and one where expense is regarded as of secondary consideration to profitable operation and efficiency.

Since it was necessary to control the electrical maximum demand and the refrigerating output, the compressors decided upon were:

Two compound clearance pocket machines, size 12x18x12.

One single-cylinder clearance pocket compressor, size 12x12.

One 6x6 twin-cylinder vertical single-acting machine.

All the compressors are direct connected to 164-r.p.m. synchronous motors with the exception of the 6x6 machine, which is belted to a 20-hp. motor.

Horizontal sheet-and-tube condensers, five in number, are used to liquefy the discharge ammonia gas, each condenser containing 1,040 sq.ft. of cooling surface. Cooling water is supplied by three 300-g.p.m. motor-driven centrifugal pumps; the water coming from three wells, and the water temperature in summer and winter is approximately 55 deg. The use of three pumps, one of which is a reserve unit, permits the pumping power to vary with the ice output. As the wells deliver only 500 gallons per minute, it is necessary to have a rise of 26 deg. in the water temperature at the condenser. This is in marked contrast to most plants when the temperature increase can be held to 10 deg. F.

In the tankroom there are 2,160 cans of 300-lb. capacity, or 10.8 cans per ton at 200 tons per day. The usual freezing time is 39 hours. Horizontal coils are run between the rows of cans, making a total of 50,000

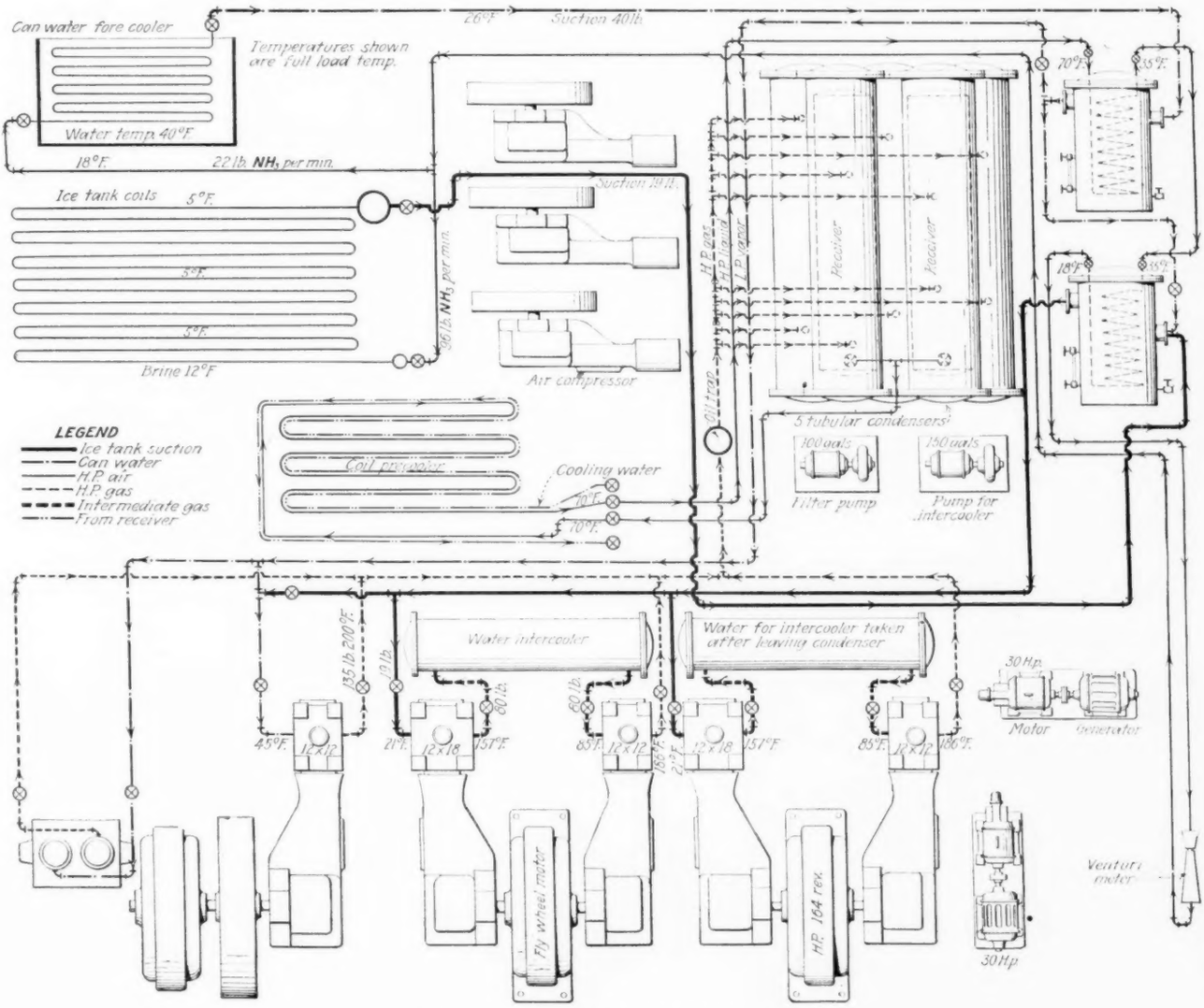


Fig. 2—Diagram of principal machinery and piping

REFRIGERATION *for the Engineer*

lin.ft. of 1¼-in. pipe. The can water is taken from the city mains and put through a filter before entering the cans.

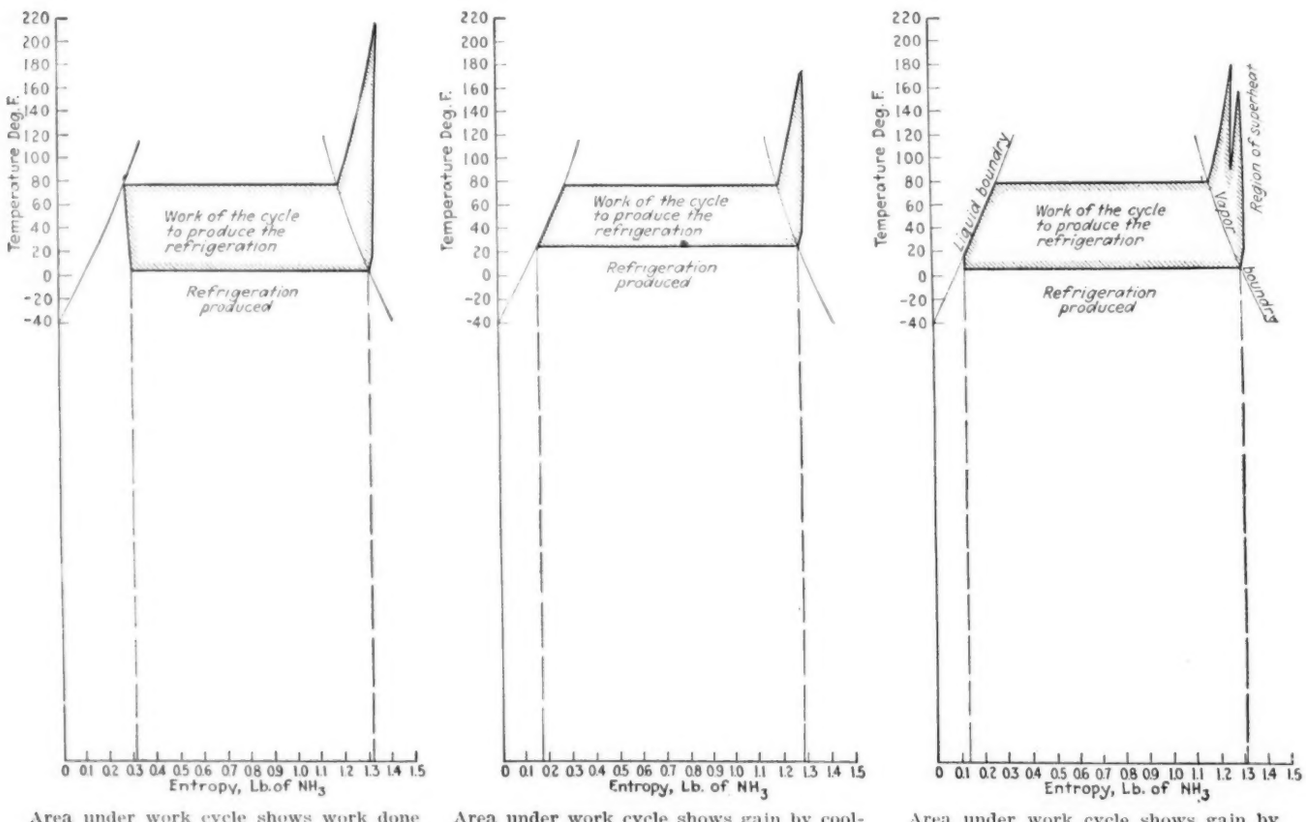
As the "Indico" system of raw-water ice making is used, high-pressure agitation is necessary. The air is supplied by three air compressors, short-belted to 20-hp. motors. The air is put through a tubular dehydrator, where it is cooled to remove part of its moisture content. Brine is withdrawn from the ice tank by a 1-in. centrifugal pump direct connected to a 3-hp. motor and sent through coils in the dehydrator. To insure good circulation of the brine in the four ice tanks 8 agitators, each direct-connected to 3-hp. vertical motors, are used.

The liquid ammonia, after leaving the condensers, passes into two horizontal receivers, each 30 in. diameter by 20 ft. long. The liquid next passes through a double-pipe cooler where it is cooled by water from 78 to 74 deg. F., after which it flows through coils placed in two suction accumulators. These accumulators are 3 ft. diameter by 7 ft. high, and each contains a coil made up of 150 ft. of 2-in. pipe. These coils are placed in series. One of the accumulators is in the suction line from the ice-tank coils, while the second is in the suction from the water forecooler coils, which is carried at a higher pressure. The can water is forecooled to 40 deg. F. and the ammonia to a point near that temperature at which it is evaporating in the ice-tank coils and forecooler.

A flexible system of forecooling of the ammonia has been devised to meet various conditions that arise through fluctuation of the ice trade. There are times when economy demands the forecooling to be done by separate machines from those engaged in making ice, and times when it is profitable to let one machine do all. As a result the ammonia liquid is forecooled as low as possible by the high-pressure suction gas, followed by cooling by the wet vapor from the ice-tank coils. Thus the superheat of the suction gas can be controlled.

The accumulators are also kept partly filled with liquid ammonia, graduated gage glasses showing how this amount varies. A system has been devised where oil will show the level of the ammonia in these accumulators. The gage glasses are in the engine room, while the accumulators are in the ice-freezing room. A Venturi meter in the liquid line measures and records the weight of liquid entering the evaporating coils.

The chief engineer has rigged up a large mercury column so that he may have absolutely correct indications of what the pressure in the tank coils is at all times. He has the column of such size that very small fluctuations of pressure are readily noticeable. The temperature at which these pressures prevail in the ice-tank coils



Area under work cycle shows work done without precooling

Area under work cycle shows gain by cooling can water at high back pressure

Area under work cycle shows gain by precooling liquid NH_3

Fig. 3—Temperature-entropy diagrams showing work of compression with one- and two-stage operation and work of precooling

REFRIGERATION *for the Engineer*

is plainly marked opposite each pressure, and he has so educated his engineers to use their heads and this column that slopovers or freeze-backs are practically unknown in this plant. This column has taken considerable time and patience to rig up, but it has more than paid for itself in the power it has saved, in the labor it has saved and in the wear and tear it has taken off the engineers.

The heat transmission between the ammonia within the tank coils and the brine averages 22 B.t.u. per sq.ft. of surface per hour per degree temperature difference. The temperature in the coils is +5 deg. F., while the brine is held at +12 deg. F. when making 200 tons of ice. The brine is sodium chloride of extra good quality and is crystal clear. A chromium salt is used to prevent corrosion and the can and coil surfaces are in cleaner condition after five years of operation than any other plant the author has seen, and the tanks have never been cleaned out. The can water is put through sand filters which are cleaned every day by only one person, the chief engineer. Promptly at noon the operation is effected, which consists of reversing the water flow and washing the refuse into the sewer. There are no dirty cores to be pumped; in this plant core pumping is obsolete, as is also discolored ice.

Compound compression with clearance pockets allows a state of dry compression to be maintained without the attending disadvantages of excessive cylinder heating—a very great economy in itself. Here is where the chief engineer must use his knowledge of refrigeration.

The plant's system of liquid ammonia forecooling is quite flexible, and it is the work of but a few minutes to alter the quality of the vapor going to the compressors from the ice tanks. Immediately this quality is changed, the power consumption is changed and anyone can note the change in the electrical consumption.

A recording demand meter shows on a long strip of paper, the amount of current being taken at all times from the electric company's mains. The greatest amount taken over a period of fifteen minutes is defined by the electric company as the customer's demand for the week. This is the basis used to compute the charges, and the actual energy consumed does not enter into the computation, save in the coal clause. The power bills are rendered weekly, and if the customer puts his power demand up to a certain point during one part of the week and fails to use this amount of power for the other part of the week, he will have to pay for the power at the high demand for the whole week.

The advantage of liquid precooling with compound compression can be proved both graphically and mathematically.

The heat equivalent of the work of compression per pound of ammonia from an ice tank coil temperature +5 deg. F. and a pressure of 19.6 lb. to a condenser pressure of 135 lb. gage is 90 B.t.u. If this pound of ammonia is evaporated at a higher back pressure of 40 lb. gage and the vapor compressed to the same condenser pressure, the equivalent of the work of compression will be 65 B.t.u., so that there is a saving of power of 25 B.t.u. per lb., although the pound of ammonia at 40 lb. gage will take up 548 B.t.u. as against 551 B.t.u. at 19.6 lb. gage. The liquid is cooled down to 18 deg. F. in both cases, so that at the high suction pressure the liquid is undercooled by 8 B.t.u. and these have to be added before evaporation starts; the high-pressure evaporation will take up 548 + 8 = 556 B.t.u., 6 B.t.u. more than at low pressure, and will require 25 B.t.u. less to compress it.

The vapor volume will be 5.22 cu.ft. per lb. at 40 lb., as against 8.15 cu.ft. at 19.6 lb., so the compressor need not be so large to handle the same weight of ammonia.

Again, in liquid cooling the greater part of the liquid cooling from 75 to 35 deg. F., is done at a high back pressure by the suction gas from the can-water forecooler. If no ammonia forecooling were done, each pound of liquid that entered the freezing-tank coils at 78 deg. F., the temperature it left the condenser, would have to expend 84 B.t.u. on itself to cool itself to a temperature where it would begin to take heat from the brine. It is plain to see these 84 B.t.u. will have to be subtracted from the latent heat at that pressure in order to arrive at the amount of heat the liquid in evaporating will take from the brine; or 565 — 84 = 481 B.t.u. are effective for cooling as against 551 B.t.u. with the liquid cooled to 18 deg. F. This is shown plainly in the charts in Fig. 3.

PRINCIPAL EQUIPMENT IN THE FULTON ICE CO. PLANT

Consulting engineer, Ophuls & Hill

Ammonia Compressors

Number .....2 compound
Size .....18x12x12 in.
Make .....De La Vergne Machine Co.
Drive .....Direct-connected to 240-hp. 164-r.p.m. Ideal synchronous motors
Size .....One single-cylinder 12x12 in.
Make .....De La Vergne Machine Co.
Direct-connected to 125-hp. Ideal synchronous motor
Size .....One twin-cylinder 6x6 in.
Make .....Frick Ice Machine Co.
Drive .....Belted to 20-hp. 230-r.p.m. Ideal motor

Air Compressors

Number .....Four
Size .....10x8 in.
R.p.m. 300
Make .....Penn. Pump & Compressor Co.
Drive .....Belted to 1,750-r.p.m. 125-volt 20-hp. d.c. motors

Agitator Pumps

Number 8
Make .....De La Vergne
Drive .....d.c. to 3-hp. vertical motors

Intercooler Pumps

Number 1
Capacity, g.p.m.....100
Make .....Goulds
Drive .....d.c. to 3-hp. motor

Filter Pump

Number 1
Capacity, g.pm.....50
Make .....Goulds
Drive .....d.c. to 2-hp. motor

Ice Conveyor

Number 1
Make .....Clifford-Wood
Drive .....d.c. to 3-hp. Ideal motor

Condenser Water Pumps

Number 3
Capacity, g.p.m.....300
Make .....Penn. Pump & Compressor Co.
Drive .....Belted to 20-hp. 860-r.p.m. Ideal Motors
Ice tank capacity, in cans 1,060
Cans, size.....11½x22½x45 in.
Gage 13

Heating and Ventilating Paramount Theater Building

IN THE Paramount Building in New York City may be seen the fulfillment of Adolph Zukor's dream, for this 35-story office building houses one of the largest and most luxurious motion picture theaters. In his dream the comfort of his audience was uppermost, and he visualized an auditorium so equipped that neither the cold of winter nor the heat of summer would interfere with the moderate temperature and fresh air required for the comfort of his patrons.

The heating and ventilation of the Paramount Building, therefore, became a dual problem, that of heating and ventilating the theater and that of heating the office building. Indirect heating and cooling was chosen for the theater, while a two-pipe vacuum system supplying direct radiation was installed for the office portion.

An idea of the general appearance of the building may be obtained from Fig. 1. At the base it fronts 200 ft. on Broadway and extends back 200 ft. along Forty-third and Forty-fourth Streets. The theater portion of the building is 12 stories high. Above the 12th floor the building is only 65 ft. deep and, because of the New York building laws, is shaped like a pyramid.

Because of the size of the building and because some of the tenants required steam throughout the year, the architects felt justified in installing a steam generating plant rather than taking steam from a central heating plant. Three 3,800-sq.ft. horizontal-drum, water-tube boilers are installed, two of which are capable of carrying the normal heating load. A 750-sq.ft. horizontal fire-tube boiler is used for providing hot water and steam during the summer.

Oil fuel is used exclusively. Each of the three large boilers is equipped with two pressure-atomizer type burners that burn sufficient fuel to produce 200 per cent boiler rating. The small summer boiler has only one burner. Oil for the burners is heated by steam to about 220 deg. F. and is supplied to them at pressures varying from 75 to 125 lb. per sq.in., depending on the steam demand.

Automatic control is provided that maintains constant steam pressure by controlling the oil to the burners and the boiler dampers. Draft gages and recording CO_2 meters aid in maintaining economic operation.

Coal bunkers are provided, and the boilers are arranged so that grates can be quickly installed for hand firing coal if for any reason it becomes impossible to secure a supply of oil fuel.

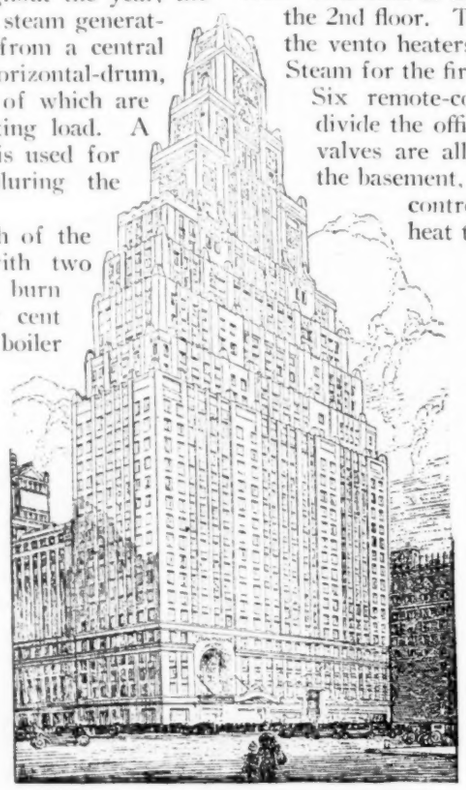


Fig. 1—The Paramount Building

Steam is generated at 40 lb. pressure and distributed through reducing valves to various parts of the building. There are four parts to the heating system: Vento heaters for supplying indirect heat to the 10th, 11th and 12th floors, and for the basements; fin-tube heaters for supplying indirect heat to the theater auditorium; direct radiation for the office building and theater; and steam to a restaurant for cooking purposes.

One reducing valve supplies steam to the theater, one to the office building and two to the restaurant; one of these for the restaurant supplies steam at 15 lb. pressure for cooking. The radiators and piping are designed so that about 1½ lb. pressure is required for proper heating during severe winter weather. During mild weather the pressure carried in the system may be reduced by adjustments at the reducing valves.

Steam to the office building is supplied through a single 14-in. riser that is reduced in size as the top of the building is approached. Branch lines from the main riser feed auxiliary down risers that in turn feed the various radiators. Steam is fed from a branch on the 33rd floor up to the 35th and from the 32nd down to the 18th. Branches at the 17th and 12th floors feed down to the 2nd floor. The branch from the 12th floor feeds the vento heaters on the 10th, 11th and 12th floors. Steam for the first floor is fed up from the basement.

Six remote-controlled valves are installed that divide the office systems into six sections. These valves are all operated from a control board in the basement, shown in Fig. 4. This sectionalized control permits periodic shutting off of heat to the less exposed side of the building, thus preventing overheating and securing heat economy.

There is 45,000 sq.ft. of direct radiation. Most of the radiators are of the cast-iron, two-column type and are equipped with modulating valve and thermostatic trap.

Condensation from the radiators is returned to a receiver tank in which a vacuum pump maintains a vacuum of 3 to 8 in. Hg. The same pump removes the condensate from the receiver and returns it to the boilers. There are two large pumps and one small pump, all three of which are shown in Fig. 3. The small pump is used during the summer months to return condensate to the small boiler, while one of the large ones serves as a spare unit.

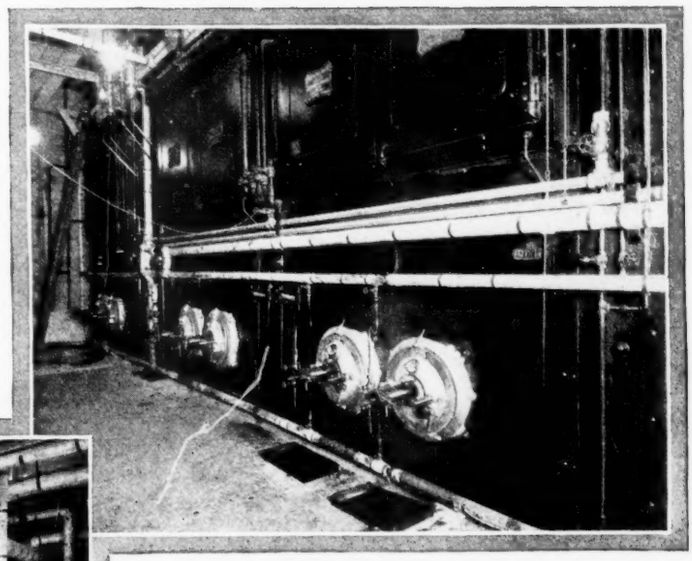


Fig. 2 (Right)—Three water-tube boilers, having a total of 11,400 sq.ft. of heating surface, supply steam for heating the Paramount Theater and office building

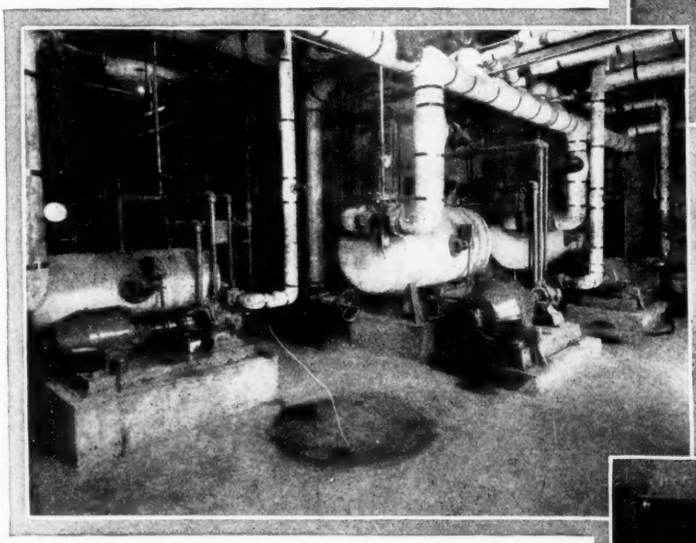


Fig. 3 (Left)—Three receivers, and vacuum pumps, that collect and return all the condensate from the heating system to the boilers

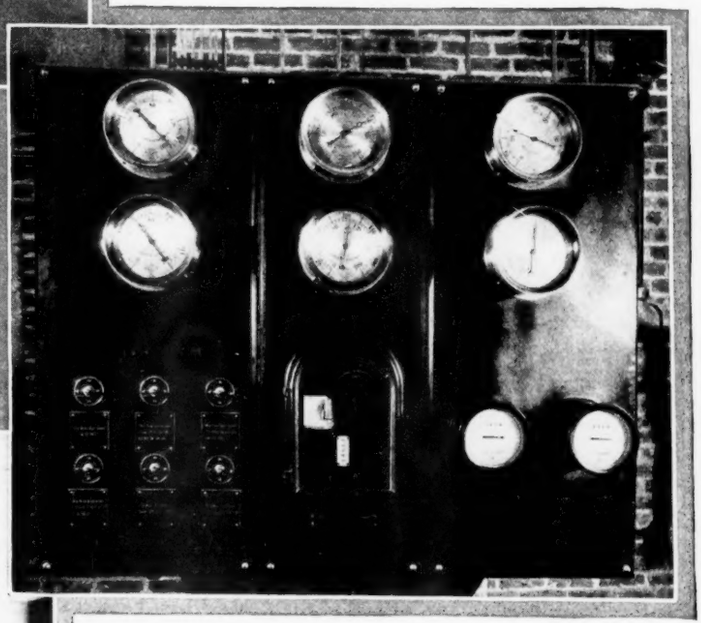


Fig. 4 (Right)—Control board located in the basement. In the lower left-hand corner is shown the controls for the sectionalizing valves

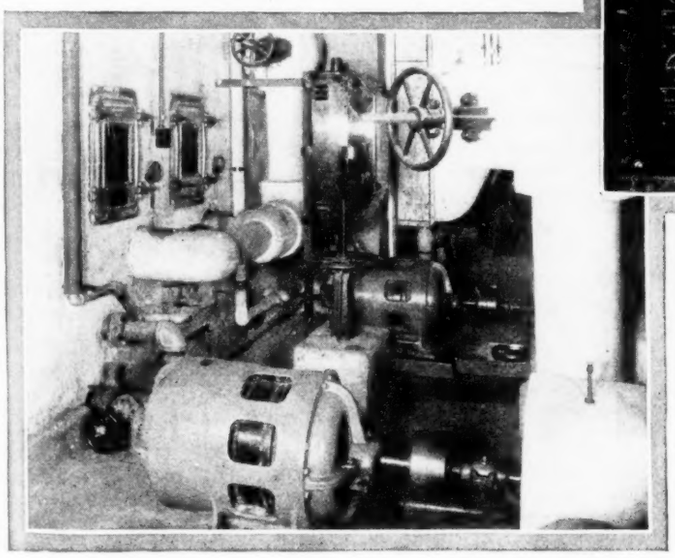


Fig. 5 (Left)—Air washer and circulating pumps. Through the windowed doors the operator may observe the water sprays

Drips from the risers are trapped into the common return header, which arrangement has not been found entirely satisfactory. If a riser trap leaks, the higher pressure steam in the riser has been found to flow through the trap in sufficient quantities to cause a loss of vacuum in the return lines.

During the last heating season an average of 58,000 gal. of oil was used per month. This high fuel consumption was due to the large amount of building construction then in progress, which necessarily caused a considerable amount of heat waste. With little construction work in progress and with most of the office space occupied, it is anticipated that the fuel consumption for the coming season will be considerably less.

Theater Ventilation

In the theater auditorium a downward system of ventilation provides clean air at a comfortable temperature and humidity. Conditioned air is blown through ventilators and diffusers in the roof of the auditoriums and in the under portion of the balcony. Vitiated air is removed through openings under the seats. A slow air movement is thus set up and the fresh air circulates downward to the breathing zone. Fig. 6 shows the general ventilation method.

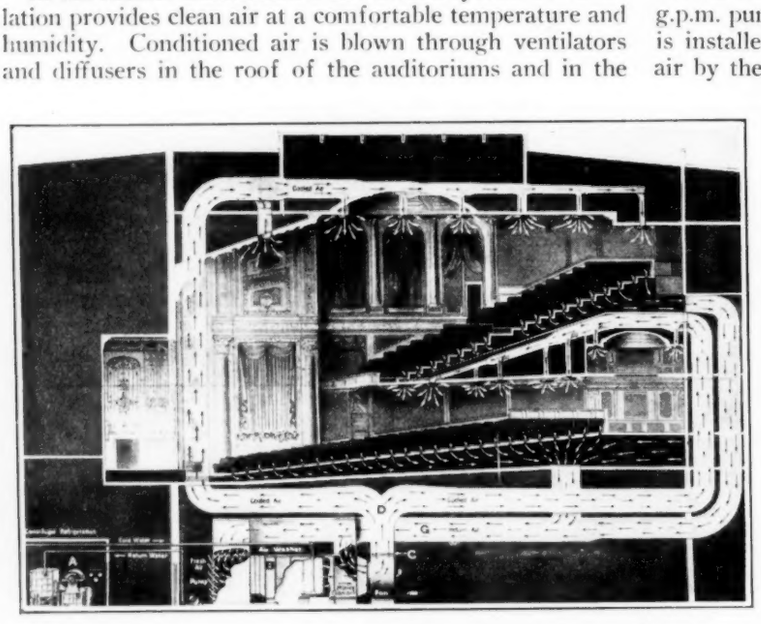


Fig. 6—Diagram showing method of ventilating auditorium

During the summer about 85 per cent of the air circulated is fresh air drawn in through a duct whose inlet is on the level of the 16th floor. The fresh air, drawn through a spray air washer, mixes with the recirculated air and is blown through the fresh-air ducts to the auditorium.

The water used in the air washer is cooled to about 50 deg. F. by two centrifugal refrigerating machines of 150 tons capacity each. This cold water in the air washer spray cools the incoming air to about 52 deg. F., thus reducing the dew point to this temperature, and also removing any dust and foul gases that may be in the air. The proportion of cooled fresh air to recirculated air is such that the air entering the auditorium has a dry-bulb temperature of about 62 deg. F. and a relative humidity of about 50 per cent. The temperature of this air, in passing down through the auditorium, is raised to about 72 deg. F. by the heat given off by the people in the theater.

Three units of air washer and fan are installed, having a total capacity of 140,000 cu.ft. of air per minute. One unit ventilates the main portion of the theater, one the balcony and one the lobby. One of these units and supply pumps are shown in Fig. 5.

The air washers are rectangular compartments forming part of the duct work, in which are a large number of nozzles that produce a fine mist-like spray. Fans draw the air through the spray and then through eliminator plates that remove all the free moisture. The spray water is collected in a settling chamber, from which it is pumped back through the refrigerating machines, where the heat taken up from the air is removed.

The settling chambers of all three air washers are connected to a common suction header so that one 1,200-g.p.m. pump can serve all three washers. A second pump is installed as a spare. All the dirt removed from the air by the water sprays collects in the settling chambers and in such quantities that it must be removed about once a week.

During the winter months only about 25 per cent of the air for ventilation is fresh air and 75 per cent is recirculated. By increasing the amount of recirculated air and decreasing the quantity of fresh air taken in from outside, the amount of heat required to warm the theater is greatly reduced. Fin-tube heating coils installed in the ducts ahead of the fans provide heat for warming up the fresh air and for making up building radiation losses. Of course during the winter the refrigerating machines are not operated.

In addition to the heating coils there is about 4,000 sq.ft. of direct radiation for the theater and lobby. The direct radiation in the auditorium is used at night when the ventilation system is shut down. The radiators in the lobby are arranged in the walls so that the ventilating air is blown over them. The ventilating air is thus heated considerably above normal to take care of the large loss of heat from the lobby to the street.

The whole ventilating system is controlled by regulating the proportion of fresh air to recirculated air and also by controlling the amount of return air that passes through the air washer, this latter control being necessary at times for proper regulation of humidity. The control is effected by wet- and dry-bulb thermostatic devices that operate dampers in the air ducts. This automatic control regulates the air to within two degrees of the desired temperature.

Of the Commercial Base Metals chromium and nickel have been shown to be the most resistant to the attacks of oxygen, carbon monoxide and sulphur dioxide, and are comparatively unaffected by these gases at temperatures as high as 1,800 deg. F. The order of resistance of attack from carbon monoxide at temperatures if 1,500 deg. F. is chromium, nickel, cobalt, copper, tungsten, and iron as determined by the increase in weight of the metal after 24 hours' exposure to the gas.

Final Devaporization of Steam in Surface Condensers

By Wm. Jay Dana, M.E.

Professor of Experimental Engineering, North Carolina State College, Raleigh, N. C.

In a previous article on "Surface Condenser Heat Transfer," published in *Power*, April 19, 1927, the author discussed the condensation of only the largest part, of the steam. In this article he shows how to calculate the surface necessary to condense the remaining steam.

IN ADDITION to condensing the major portion of the steam, it is necessary (for good condenser performance) to devaporize the remaining 1 per cent; it is advantageous to cool the air in the condenser before its removal by the air pump; and it may also be necessary to cool the condensate a few degrees. All these processes require additional condensing and cooling surfaces. It was suggested in the previous article that the designer could use a rough rule of adding 25 per cent to the surface calculated for condensation of the 99 per cent in the first step. Let us examine these processes in detail, however.

Cooling of the air flowing through the condenser will help the air pump, as there will be a smaller volume for it to handle. Cooling of the air, however, as much as 20 deg. F. will not add an appreciable amount of tube surface to the condenser, as the calculations given later will show.

Cooling of the condensate is not desirable from the heat-balance point of view, but is necessary thermodynamically, as there must be a drop of a few degrees in the temperature of the steam as it flows through the tube bank on account of the air present, or there cannot be condensation. If the designer wants to *reheat* the condensate in the bottom of the condenser or in the hotwell, it may be done by arranging the steam flow for that purpose. Many modern condensers have been designed with steam lanes that effect reheating of the condensate.

The final devaporization of the 1 per cent steam, however, requires considerable surface for two reasons: First, it should be cooled at least 10 deg. F.; second, it is a very rich air-steam mixture. On account of the large percentage of air in this air-steam mixture the heat-transfer coefficient is low.

The devaporization of this final 1 per cent of steam materially aids the air pump, especially if it is the latest type, namely, a steam-jet air ejector. Handling of steam by the air ejector is not very efficient.

Owing to the presence of the air in the condenser the temperature of the steam does not correspond to the saturation temperature corresponding to the condenser pressure, but as the quantity of steam is reduced through condensation, there is a reduction of its partial pressure and consequently of its temperature.

As there is always some air present in the steam entering the condenser, even though it be a very small quantity proportionately, the vacuum attainable depends upon adequate removal of the air as well as the condensation of the entering steam. The air may be removed by means of any suitable air pump, however, and therefore this subject will not be covered in this article.

Design Calculations

The cooling surfaces necessary for condensing the steam, cooling the air, cooling the condensate, and final devaporization can in general be expressed by the equation,

$$S = \frac{N}{\theta_m \times K}$$

in which S is the cooling surface in square feet., N the total heat to be transferred, θ_m the logarithmic mean temperature difference, and K the coefficient of heat transfer.

More specifically the subscript s will be used for the steam condensation part, the subscript a for the air cooling part, the subscript c for the cooling of the condensate, and the subscript v for the final devaporization. The equations for determining the surfaces of the four parts of the condenser become

$$S_s = \frac{N}{\theta_s K_s}, \quad S_a = \frac{C_p N_a}{\theta_a K_a},$$

$$S_c = \frac{N_c}{\theta_c K_c}, \quad \text{and} \quad S_v = \frac{N_v}{\theta_v K_v}$$

Since the arithmetic mean temperature difference is quite close in value to the logarithmic mean temperature difference for the usual temperature ranges in a surface condenser θ_s θ_a, θ_c and θ_v will be used to represent arithmetic mean temperature differences.

The total heat in the exhaust steam N_s, is determined in the usual way from the equation,

$$N_s = W_s\,[xL - (t_s - 32)]$$

in which W_s is the weight of steam flowing to the condenser per hour, x is the quality of the exhaust steam, L is the latent heat in the exhaust steam, and t_s is the temperature of the entering exhaust steam.

The mean temperature difference θ_s must be determined from the particular conditions and assumptions.

Tests that have been made by various investigators to determine the value of the coefficient of heat transfer K for individual tubes show that while high values can be obtained, yet for the whole condenser the average value of K is low. Apparently, the chief reason for this result is that the condensers were not designed to suit the steam or air flow. If the design is split up into parts which consider the steam and air flow separately, a much higher value of K for the whole condenser may be obtained.

Coefficient of Heat Transfer

Fig. 1 shows the value of K, with an assumed velocity of circulating water of 6 ft. per sec., to be 800 B.t.u. per sq.ft. per deg. per hour. Professor Josse has stated that the coefficient of heat transfer of air to metal is small, and if that for steam is 2,000, then for air it is one. Assuming this ratio of 2,000 to 1, K_a becomes $\frac{800}{2{,}000} = 0.40$. This value may be used for design purposes until more specific data are obtained.

In order to clarify the preceding discussion, the calculations necessary to determine the surface of a condenser for a 20,000-kw. unit with bleeder turbines will be carried through.

It is assumed that the turbine is supplied with steam of 710 deg. F. and 350 lb. pressure, that the highest summer circulating water temperature (t_1) is 75 deg. F., and that the condenser is two-pass with 18-ft. brass tubes 1 in. O.D., No. 18 B.w.g. For a two-pass condenser a rise of 12 deg. can be obtained in the circulating water as it passes through the tubes. This gives an outlet temperature t_0 of 87 deg. F. Assuming a difference of

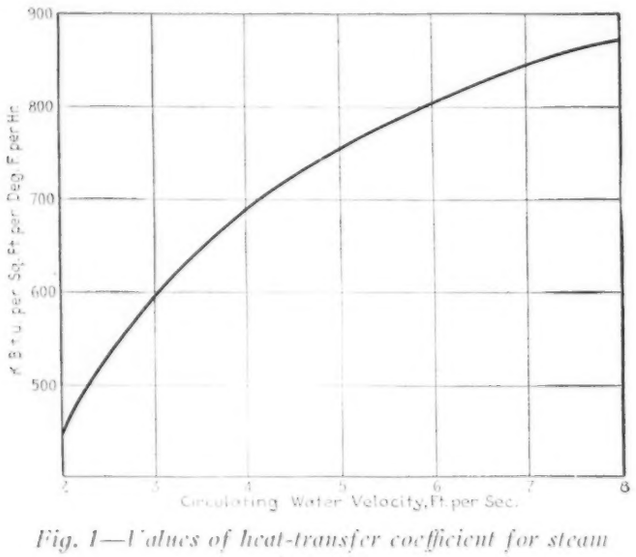


Fig. 1—Values of heat-transfer coefficient for steam to water

5 deg. between the exhaust steam and the outlet circulating-water temperature, the exhaust-steam temperature will be 92 deg. F., which corresponds to a back pressure of 1.508 in Hg.

Of the steam entering through the turbine throttle, it is assumed that 16 per cent is bled to the stage heaters, leaving 84 per cent to be exhausted to the condenser.

The heat in a pound of steam at the throttle is 1,359 B.t.u. With adiabatic expansion of the steam the heat at exhaust would be 915 B.t.u. and would have a quality of 82 per cent. As there is always some reheating of the steam due to friction with the turbine blades, the quality would probably be increased to at least 92 per cent. This would give 1,017 B.t.u. in the exhaust steam at 1.5 in. Hg. back pressure.

If the temperature of the condensate is 3 deg. below the temperature corresponding to the condenser pressure,

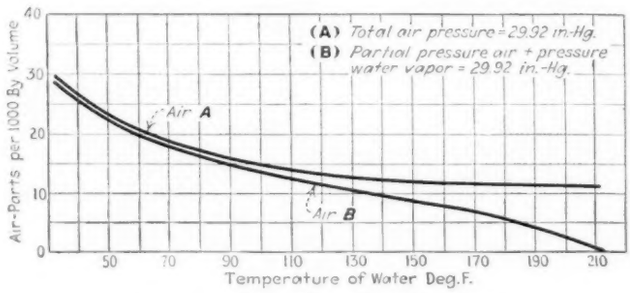


Fig. 2—Solubility of air in water

the heat contained in the condensate will be 92 deg. — 3 deg. — 32 deg. = 57 B.t.u. above 32 deg. The total heat rejected to the condenser at an assumed guaranteed water rate of 11.75 lb. of steam per kilowatt-hour is then

$$20{,}000 \times 11.75 \times (1{,}017 - 57) \times 0.84 = 190{,}000{,}000 \text{ B.t.u. per hour}$$

The arithmetic mean temperature difference can now be determined and is $\theta_s = 92 - \frac{87 + 75}{2} = 11.00$, and the heating surface required to condense the first 99 per cent of the steam is

$$S_s = \frac{H_s}{K_s \theta_s} = \frac{190{,}000{,}000 \times 0.99}{800 \times 11} = 21{,}400 \text{ sq.ft.}$$

Surface Required to Cool Air

The air and uncondensed vapors should be cooled at least 10 deg. F., so that the additional heat to be removed after the first period of steam condensation would be cooling the air 10 deg., cooling the condensate, and final devaporization.

Assuming $K_a = 0.40$, we may calculate the additional cooling surface required for the air cooling.

Certain assumptions, however, must be made with regard to the amount of air that would be present in the exhaust steam of the condensate. With the condensate at 89 deg. F. the solubility curve Fig. 2 shows 14.5 parts of air per thousand. The raw feed water, however, at a temperature of 75 deg. F. will have 18 parts of air per 1,000, and in addition there will be leakage of air into the condenser. Assuming, therefore, 20 parts of air by volume in 1,000 parts of water, the volume of air per cubic foot of water is 0.02 cubic foot.

The weight of 0.02 cu.ft. of air at 82 deg. F. is, $w = 0.02 \times 0.0735 = 0.00147$ lb., and the ratio of weight of air to water is $r = \frac{0.00147}{62.2} = 0.0000236$.

This gives the ratio by weight of the maximum amount of air in the raw feed water, which may be only 3 per cent of the total feed water. In a closed system the air present in the condensate is about one-tenth of the above amount. It will be assumed, therefore, that the actual air under good operating conditions will be (0.97) (0.00000236) + (0.03) (0.0000236) = 0.000003098, or, say, 0.0000031 the amount of steam by weight.

The amount of steam flowing to the condenser per hour is $20{,}000 \times 11.75 \times 0.84 = 197{,}000$ lb., and the amount of air contained in it is $197{,}000 \times 0.0000031 = 0.612$ lb. The volume of this air at 82 deg. F. is $\frac{0.612}{0.0735} = 8.33$ cu.ft. per hour.

As this figure is considerably below actual practice, it will serve to indicate the amount of air ordinarily leaking into the condenser. The tests reported by F. J. Chatel, of the Detroit Edison Company, in his paper "Steam Condenser Practice and Performance," read at the December, 1926, meeting of the A.S.M.E., shows the amount of air delivered from the various large condensers at full load to be from 4.35 to 7.56 cu.ft. per min. The lowest of these figures, 4.35 cu.ft. of air per min., or 261 cu.ft. per hour, is over 31 times as much air as calculated above for the amount entering the condenser with the steam. It is obvious, therefore, that by far the largest percentage of air comes from air infiltration.

For the purpose of calculating the amount of air cooling surface required, the high figure 480 cu.ft. of air per hour, or $480 \times 0.735 = 35.2$ lb. per hour, is used. Assuming air cooling of 10 deg. with a 5-deg. heat head, the arithmetic mean temperature difference in the air cooler portion is

$$\frac{t_s - t_a}{2} - \frac{t_o + t_1}{2} = \frac{92 + 82}{2} - \frac{77 + 75}{2} = 11.0 \text{ deg.}$$

The air cooling surface, assuming the specific heat (c_p) of saturated air as 0.248 will then be

$$S_A = \frac{c_p H_A}{\theta_A K_A} = \frac{0.248 \times 35.2 \times 10}{11 \times 0.40} = 19.8 \text{ sq.ft., say } 20 \text{ sq.ft.}$$

Cooling of the Condensate

Although any considerable amount of cooling of the condensate is undesired, a few degrees are required, as there must be some drop in temperature of the steam in order to get complete condensation. If a drop of 3 deg. F. and a heat transfer coefficient of 25 is assumed, the surface required to cool the condensate is

$$S_c = \frac{20{,}000 \times 11.75 \times 0.84 \times 3}{25 \times 11} = 2{,}160 \text{ sq.ft.,}$$

the mean temperature difference (11.0) having been first obtained as follows:

$$\theta_c = \frac{t_s + t_a}{2} - \frac{t_o + t_i}{2} = \frac{92 + 89}{2} - \frac{84 + 75}{2} = 11.0 \text{ deg.}$$

Devaporization

After passing through the majority of the condensing surface, there will still be at least 1 per cent of the steam uncondensed. This vapor is mixed with the air that now forms a large percentage of the mixture so that the heat transfer coefficient is very low, probably about 4.0.[1]

The surface required for condensing the remainder of the steam and cooling it 10 deg. is therefore

$$S_v = \frac{197{,}000 \times 0.01 \times [1{,}017 - 57 + 10]}{4 \times 11} = 4{,}340 \text{ sq.ft.}$$

[1] Gebhardt's "Steam Power Plant Engineering," page 526 Sixth Edition.

A summation of the cooling surfaces calculated for the various condenser parts follows:

Preliminary steam condensation, 99 per cent	21,400
Air cooling	20
Cooling condensate	2,160
Final devaporization, 1 per cent	4,340
Total	27,920

It will be noted that a total of 6,520 sq.ft. of cooling surface is required for the "air cooler," which is only 23.4 per cent of the total cooling surface. This is small compared to some of the condensers recently built, but ample if the tube sheet is laid out with differential tube spacing.

Number of Tubes Required

If it is assumed that the tubes are 18 ft. long, 1 in. O.D., and No. 18 B.w.g., the cooling surface per tube is $\frac{18 \times 12 \times 3.14}{144} = 4.71$ sq.ft. and the total number of tubes is $\frac{27{,}920}{4.71} = 5{,}920$.

The quantity of circulating water that will pass through the tubes at the velocity of 6.0 ft. per sec., previously assumed in determining $K = 800$, is 35,400 gal. per minute.

This gives a ratio of 90 lb. of circulating water per pound of steam, which is about the average for present practice.

The first (lower) pass may be arranged to have a lower water velocity than the second (upper) pass. This may be done by dividing the water-boxes and tube-sheet layout so that there will be about 60 per cent of the tubes in the first pass and 40 per cent in the second pass.

Checking back, we find that the average coefficient of heat transfer is

$$K = \frac{197{,}000 \times 960}{27{,}900 \times 11} = 617$$

This is considerably above the average used in the past, but not up to actual test results now being obtained. If the designer is doubtful of using so "high" a coefficient, he may add surface, but it must be borne in mind that this figure stands only for one month in the year, July or August, and during the months of cooler circulating water the vacuum will be better and the average heat-transfer coefficient considerably lower on account of the much larger arithmetic mean temperature difference. In fact, with 35 deg. F. cooling water during the winter months, the arithmetic mean temperature difference will be at least double the summer figure of 11 deg. K will be about one-half, or around 320, therefore, in the winter, with a vacuum of 29.30 in. of mercury. In addition to this a satisfactory vacuum may be maintained during the winter months with less circulating water at considerably less pumping power.

Condenser Tube Scale may sometimes be effectively removed by treating the tubes with a solution of hydrochloric acid. The proper concentration to use is a 2.5 per cent solution by volume for a treatment of one hour's duration. If it is more desirable, either from the point of view of economy or from that of time required to clean the condenser, a 1.25 per cent solution of acid can be used for a two-hour period, or a 5 per cent solution for a treatment of one-half hour's duration.

EDITORIALS

F. R. LOW, *Editor*

Narrowing Margins of Profit—An Opportunity for the Industrial Power Plant

THE National Industrial Conference Board reports that during 1926, in a group comprising 100,000 firms in the United States, approximately one-third of them operated without profit, many with substantial deficits. Their report further indicates that many firms operate with a margin of profit of only five per cent.

It is perhaps true that the less profitable firms are the smaller ones and that the profitable conduct of business is drifting into the hands of the large corporations. All the more reason for the small manufacturer to scan the road ahead and see whither he is going and why. Through intelligent study of his costs and methods he may be able to hold his own for a long time. Among other things his power plant may deserve a bit of attention. If he is losing money, it probably needs it.

If a manufacturer makes a product that costs him fifty dollars, and sell it for one hundred dollars, a change of ten per cent in the cost of the product will produce a change of only ten per cent in his profit, but if he sells that article for fifty-five dollars, a change of ten per cent in his cost will either wipe out the profit altogether or double it, and apparently it is in this range that American industry is operating today, at least to a significant extent, and perhaps to a growing extent.

Now it has frequently been stated that the power cost in many manufacturing industries is only a small percentage of the total cost of the product, and in many cases this is obviously true. From this it is frequently argued that the manufacturer is not justified in spending time and money attempting to improve the efficiency of his power plant, because any such improvement would be just a small portion of his total cost.

This is doubtless true, but with industry operating on a narrow margin of profit, would it not be better to consider possible savings in the power plant in relation, not to the cost of the product, but to the profit? With a five per cent margin of profit, one per cent of the cost becomes twenty per cent of the profit, and it is easily possible that the savings that could readily be effected by an intelligent rehabilitation of many an old power plant might assist materially in changing the bookkeeper's ink from red to black.

Too many manufacturing executives act under the influence of tradition rather than under the guidance of reason. It has long been the fashion in many industries to neglect the power plant and assume that any aggregation of antiques that will produce steam and turn a flywheel is plenty good enough for practical operating plants, and that anything better or more up to date is simply frills and ginger bread. It is high time that the American manufacturer opens his eyes to what the power engineer is doing.

Facilitate Boiler Inspection

ANOTHER boiler explosion, that at Harvey, Ill., is added to the long list of disastrous failures traceable to corrosion and grooving in that section of the drum head commonly referred to as the heel of the flange. About fifteen years ago, following an epidemic of failures of this character, the A.S.M.E. Boiler Code was revised so as to provide for greater stiffening of the head, near the flange, and thus more effectively resist breathing action. In consequence, boilers built according to the Code, subsequent to this revision, have been particularly free from such failures.

There are, however, many older boilers still in use where the drums have not been renewed and where bad feed water is encountered. In such cases it is imperative that thorough inspections be made and constant watch maintained on conditions.

At Harvey the water was known to be corrosive and conditions became so acute in 1924 that a change was made to lake water. The boilers had become badly pitted. The head that failed appears to have corroded both inside and out. A thorough internal inspection should have revealed that on the inside, but a brick encasement rendered the outside inaccessible.

Here again is a lesson for those operating boilers carried in old-style settings. Designers now recognize the need of proper facilities for inspection of the external surface of drum heads, and the newer installations afford access to practically all parts of the boiler; but few of the older settings have been changed, so that the blind head of the mud drum remains incased in the brickwork and inaccessible for examination.

The expense of installing a frame and inspection door in the furnace wall of a single setting, opposite the blind head, or a division plate between the mud drums of two

boilers set in a battery, or the replacement of a drum when necessary, is insignificant compared to the loss of production, property damage and injury to employees likely to result if a defective head is continued in operation until failure occurs.

Oil in the Refrigerating System

MORE than one ammonia compressor has had its cylinder scored by the too cautious use of cylinder lubrication.

Even those engineers grown gray in service have a horror of oil getting into the evaporating coils. On taking down one of these coils, the thick coating of oil is ample evidence that the rate of heat transfer is reduced much below that obtained from a clean coil. The deduction usually made is that oil should be kept out of the systems, and this is taken to mean a reduction of the cylinder lubrication to a minimum often below the danger line.

Since oil should not be left in a coil, it by no means follows that the cylinder need be starved. Neither does it prove that oil cannot be made to pass through a coil without adhering to the surface.

Oil mixes readily with ammonia, and the emulsion will pass safely through a coil provided the coil is not empty. If the oil contacts with a part of a coil free from liquid ammonia, it will adhere, but its removal is a matter of but a few minutes. All that need be done is to close off the expansion valves and suction outlet valves of all but one or two coils. The rapid evaporation of the liquid in these few coils will set up such a gas velocity that the oil will be swept away into the suction line, when it can be trapped out.

A few minutes per coil spent weekly in this way will go far toward the elimination of the trouble with cylinder scoring.

Why Handicap Hydro-Electric Developments?

WHAT water power is capable of doing for the human race, has been extolled by legislators and others until their plaudits of this natural resource have become axiomatic to the layman. Develop our water powers so as to put cheap power within the reach of everyone; develop our water powers and save our coal—these are entreaties that have been repeated so often that they have become commonplace. One governor has said that he would develop the water power of his state so as to put cheap power within the reach of every washwoman and cobbler.

Such expressions regarding water-power development could be multiplied almost indefinitely. But, notwithstanding all the entreaties for utilizing water power, there is the paradoxical condition, that many of those who shout the loudest for its development, insist upon placing its utilization under heavy handicaps. Only recently, the State of Alabama imposed a tax of four-tenths of a mill on each kilowatt-hour of hydro-electric power produced and sold. At the same time the coal tax was increased to two and one-half cents per ton. Under average conditions this will amount to a tax of less than two-hundredths of a mill per kilowatt-hour generated from coal.

This tax is about twenty-five times as great on hydro-electric power as on power generated from coal. On a hydro-electric unit producing one hundred million kilowatt-hours per year, this tax amounts to forty thousand dollars, where on a similar steam unit it would be about seventeen hundred dollars. If those responsible for this tax had deliberately schemed to waste their state's fuel resources, they could not have conceived a better plan.

Fuel taken from the ground and burned is gone and cannot be replaced, while water power is self-perpetuating. A water power developed will be capable of generating the same kilowatt-hours fifty years hence as now, whereas a coal mine supplying fuel for the same power output may be entirely worked out in the same period. Of the coal mined, all that may be left is an ugly hole in the ground and a more ugly landscape.

If water power could be developed and carry a handicap in competition with steam plants, there might be some justification for such a tax. Recent developments in steam-plant design and low-priced fuel have, in many cases, placed hydro-electric projects at a disadvantage with the steam plant. Then, why increase the handicap by disproportionate tax?

Fundamental Research in Heating and Ventilating

THE American Society of Heating and Ventilating Engineers is greatly to be complimented for the fundamental research accomplished by its Research Laboratory. This work receives its financial support from three principal sources. Two-fifths of the annual membership dues forms half of the laboratory's income. The remaining half is obtained from the sale of the "Guide" and from individual contributions.

Realizing the great value of the work of this organization, and desiring to insure its permanence, several chapters of the society have inaugurated a plan for creating a fund to be used as an endowment for the Research Laboratory.

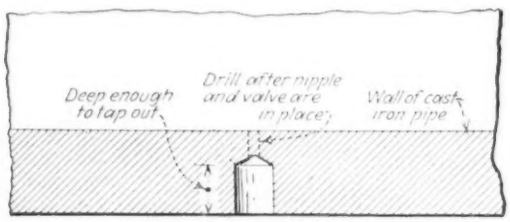
This plan merits high praise because it not only provides for the continued activity of the research organization, but also tends to insure unbiased research endeavor in a field where accurate knowledge is sorely needed by the designer of equipment and by the architect.

IDEAS *from* PRACTICAL MEN

Readers are urged to use this department for the exchange of practical operating information. A minimum of five dollars will be paid for contributions accepted

Drilling and Tapping Cast-Iron Water Pipe With Pressure On

TO DRILL and tap holes in a pipe with water pressure on is sometimes a wet job. We had occasion to make some ¼-in. gage connections on each side of a circulating-water pump at the plant. There was a positive head of 10 ft. of water on the suction of the pump and no valve in the line. The pump connections at the suction and



Pipe is drilled part way, tapped and the valve connected before hole is drilled through

discharge are made with cast-iron pipe having a wall thickness of approximately 1½ in. In order to do the job as quickly as possible we used the following method:

The proper size of drill for the pipe tap was used, and with an electric drill the hole was bored just deep enough to allow for tapping, but not through the entire thickness of the metal. The hole was tapped and a short nipple screwed into it. A gate valve was then screwed on the nipple, thus completing the pipe connection. A twist drill small enough to go through the valve was used to finish drilling the hole through the cast-iron pipe. When this was done, the drill was withdrawn and the gate valve closed.

The job was completed with practically no water escaping. To drill the hole through in the first place and then tap it, is a wet job and a dangerous one, if there is electrical apparatus nearby. L. R. RAWSON.

Denver, Colo.

Removing Grease and Rust From Machinery

DURING the rehabilitation of a plant that had stood idle for some time, it became necessary to clean an engine and several machines thoroughly.

After scraping and scrubbing with kerosene and emery cloth had proved too slow and tedious, three baths were rigged up in two washtubs and a half-barrel, which did the cleaning quickly and thoroughly. In one tub was dissolved some potash, until the watery solution would float an egg. The second galvanized steel washtub was filled with an equal amount of clean water. The half-barrel was partly filled with a dilute solution of acid, either sulphuric or hydrochloric, as chanced to be available. In case a hydrometer was not at hand, the acid solution was made just strong enough to show gas bubbles after a piece of metal had been immersed for a few minutes.

The machines were dismantled and the parts scraped free from thick grease and dirt deposits and thrown into the alkali bath, which was heated if necessary. A common scrub-brush was cut in half and a two-foot handle screwed to each half, and these were used to scrub the parts while in the bath.

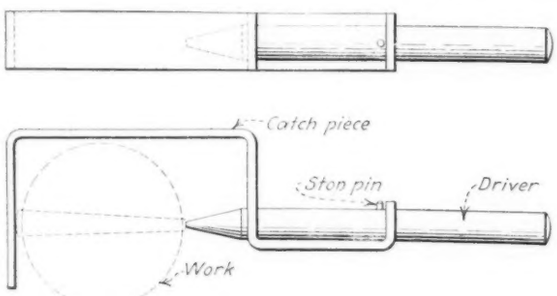
As soon as freed from the grease, the metal parts were placed in the water and well rinsed and then passed into the acid tub, where the rust was removed. Then, a final rinse in the clear water made the pieces ready to be wiped and reassembled. JAMES F. HOBART.

Indianapolis, Ind.

Tool for Knocking Out Taper Pins

A TAPER pin can be knocked out with almost any kind of a tool with a pointed end, but catching the pin on the other side is often difficult. One tap, with sufficient force behind it, will usually send the pin flying, and it might easily drop where it would not be an easy matter to recover it. The illustration shows a tool I have devised for preventing a taper pin from flying out of the hole when it is struck with the hammer.

It is made in two parts, a catch piece made out of a strip of ⅛-in. sheet metal bent as shown, and a driver



Taper pin driver with holder prevents pins being lost

made out of round steel. The catch piece is drilled to take the driver, and a small stop pin is driven in place to keep both parts together.

When the tool is in use on any size of work within its capacity, the catch piece is hooked over and the driver shoved up to touch the pin, then struck with the hammer.

Hamilton, Ont., Canada. H. MOORE.

Data Form Sheet for Recording a Series of Boiler Tests

THE accompanying illustration shows a form developed by the American Engineering Co., for recording boiler test data. This form has proved practical and useful, as it allows complete data of any number of tests to be entered on a sheet which is letter size for one test and can be folded to fit into a letter size book when more than one test is run. Furthermore, all data are in convenient form for study and comparison and by making the form on vellum paper, any number of blueprint copies can be produced quickly. It occurred to me that this form might be of interest to other readers.

This form was designed to be adaptable for tests in a large number or varied types of stoker-fired plants, but in some cases it may be necessary to add a few special items, or some, shown on the present form, may be omitted. It does, however, include all the essential items for the average plant.

Philadelphia, Pa. J. S. BENNETT,
American Engineering Company.

SUMMARY OF TESTS SERIAL No. .....
NAME OF COMPANY

Company .....
Plant .....
Location .....

BOILER
Type .....
No. Passes .....
Tubes High .....
Tubes Wide .....
Setting Height, low end .....
Furnace Width, Ft. .....
Furnace Vol., Cu. Ft. .....
Boiler, H. S., Sq. Ft. .....
Side Wall, H. S., Sq. Ft. .....

SUPERHEATER
Sup. H. S., Sq. Ft. .....

ECONOMIZER
Econ. H. S., Sq. Ft. .....

AIR PREHEATER
Type .....
Location .....
Preheater H. S., Sq. Ft. .....

STOKER
Type .....
Size .....
No. Crusher Rolls .....
Size Crusher Rolls .....
Depth Crusher Pit .....
Grate Area, Sq. Ft. .....
Operated by .....

RATIOS
Ratio of Grate Surface to Boiler Surface .....to 100
Ratio of Economizer Surface to Boiler Surface .....to 100
Ratio Preheater Surface to Boiler Surface .....to 100
Cu. ft. of Furnace Vol. per rated B. H. P. .....

REMARKS .....

APPROVED BY .....

APPROVED BY .....
A. E. CO.

ORDER NO.

REF. DWG.

	Boiler Number				
	Number of Test				
	Date				
	Duration in Hours				
	Percent. Rating (Boiler and Superheater)				
	Percent. Rating (Boiler, Superheater and Economizer)				
	Comb. Efficiency (Boiler, Superheater, Economizer and Preheater)	%			
HEAT BALANCE (A.F.)	Heat Absorbed by Boiler and Superheater (with Preheated Air)	%			
	" " " Economizer	%			
	" Loss due to Dry Flue Gases	%			
	" " " " Moisture in Coal	%			
	" " " " Hydrogen in Coal	%			
	" " " " CO	%			
	" " " " Comb. in Refuse	%			
	" " " " Rad. & Unaccounted for	%			
	Total	%			
FLUE GASES	CO_2 in pass of Boiler	%			
	CO_2 Boiler Outlet	%			
	CO_2 Economizer or Preheater Outlet	%			
	CO in pass of Boiler	%			
	CO Boiler Outlet	%			
	CO Economizer or Preheater Outlet	%			
	Steam Press. lbs. per sq. in. Gauge				
	Factor of Evaporation (Boiler only)				
TEMPERATURES	Total Temperature of Steam	Deg. F.			
	Degrees of Superheat	Deg. F.			
	Temperature Gases Leaving Boiler ( )	Deg. F.			
	" " " Economizer or Preheater	Deg. F.			
	" Air Entering Preheater or Windbox	Deg. F.			
	" " Leaving Preheater	Deg. F.			
	" H_2O Entering Economizer	Deg. F.			
	" H_2O Leaving Economizer or Entering Boiler	Deg. F.			
AIR PRESS.	Air Duct	Ins. Water			
	Windbox	Ins. Water			
	Extension Grate	Ins. Water			
	Press. Drop Through Preheater	Ins. Water			
DRAFT	Draft Over Fire	Ins. Water			
	" Boiler Outlet	Ins. Water			
	" Loss through Economizer	Ins. Water			
	" " " Preheater	Ins. Water			
COAL & ASH ANALYSIS	Name of Fuel				
	Moisture in Coal	%			
	Volatile Matter in Coal	%			
	Fixed Carbon in Coal	%			
	Ash in Coal	%			
	Sulphur (Determined Separately)	%			
	Comb. in Refuse	%			
	B. T. U. per lb. Coal as Fired				
	Lbs. Coal Burned per hr. per sq. ft. Proj. Grate (as fired)				
	" " " per hr. per cu. ft. Comb. Space " "				
	" " " per hr. per retort " "				
	B. T. U. Liberated per cu. ft. of furnace vol. per hr.				
	Fusing Temperature of Ash	Deg. F.			

Boiler test form designed to permit recording a number of tests on one sheet to facilitate study and comparison

COMMENTS *from* READERS

A Boiler Inspector Has an Exciting Experience

SOMETIME ago a boiler inspector visited a Brooklyn factory for the purpose of examining some boilers that had been retubed and otherwise repaired. They were horizontal fire-tube boilers, well built and amply safe for the 100 lb. steam pressure normally carried. When the inspector arrived at the plant, he found one of the boilers in operation and the other two shut down and ready for inspection. After finishing his examination of one of the boilers, he was startled by a sharp report followed by a hissing noise. He knew at once that a gasket had blown out, and he ran around to the front of the boiler to look at the steam gage. The hand of the gage was at the zero point, but the inspector knew that the gasket would not have blown unless there was pressure on the boiler. Looking more closely, he saw that the hand was bent, indicating that it had gone clear around the gage and was hard against the other side of the stop pin. Instead of no pressure there was more than 250 lb. on the boiler.

By this time steam was beginning to hiss from the riveted seams and the inspector immediately grabbed a shovel and threw enough green fuel on the fire to smother it. The pressure presently began to drop and the inspector and the engineer were beginning to get over their excitement, when an explosion occurred that blew open the furnace doors and threw them both to the floor. They thought their end had come; but fortunately the boiler had not exploded and they were more frightened than hurt. Someone unobserved had closed the damper in the stack, and this had allowed fuel gas to accumulate and explode in the furnace.

Next day, when the boiler had cooled off, the inspector made a thorough examination. That it had been stretched by the excessive pressure to which it had been subjected was obvious. The amount of the stretch could be measured where the shell plates overlapped at the longitudinal seams of the boiler. This stretch, however, was not sufficient to injure the metal, and after the rivets had been redriven, the seams recalked, and the tubes rerolled, the boiler was subjected to a hydrostatic pressure of 150 lb. and found to be tight and safe. This boiler still is in operation and is giving good service.

The cause of the trouble was soon discovered. The safety valve on this boiler had been set to blow at 100 lb. gage, but the day before the excitement occurred the boiler had been subjected to a hydrostatic test. To apply this test the engineer had removed the safety-valve lifting lever from the bonnet and had screwed the nut down on the spring so that the valve would hold tight at the 150 lb. of test pressure required. After applying the test the engineer replaced the lifting lever in the bonnet, but he forgot to unscrew the nut on the safety-valve spring.

Accidents, where safety valves have been screwed down to apply a hydrostatic test and where they have been allowed to remain in this condition after steam pressure has been raised on the boiler, are frequent. I recall an incident where a boiler located in the heart of the financial district of New York City had been subjected to a hydrostatic test. To accomplish it, a piece of 2 x 4 in. studding was wedged tight between the safety-valve lever and an overhead ceiling beam. Fortunately, an insurance inspector discovered this condition before steam was raised on the boiler.

It is to be observed that the most violent of all boiler explosions are those that occur when the safety valve has been blocked from some cause or other. After the application of a hydrostatic test, the engineer should satisfy himself that the safety valve has been unblocked and that it is free to blow at the pressure required.

WILLIAM H. BOEHM, Vice-President,
Dept. of Boiler, Engine and Flywheel Insurance
The Fidelity and Casualty Co.
New York City.

* * * *

Improper Distribution of Air on Underfeed Stoker Causes Grates to Burn Out

REFERRING to Mr. Croft's query in the Oct. 18 issue on the correct distribution of air beneath underfeed stokers, it is quite evident from the illustrations shown by Mr. Croft and reproduced herewith that Fireman No. 2 has the correct method of firing. In any underfeed stoker the maximum efficiency is obtained by burning at least 75 per cent of the coal on the first half of the stoker, and this can be accomplished only by a sufficient supply of air at point *A*, Fig. 2, to insure complete combustion.

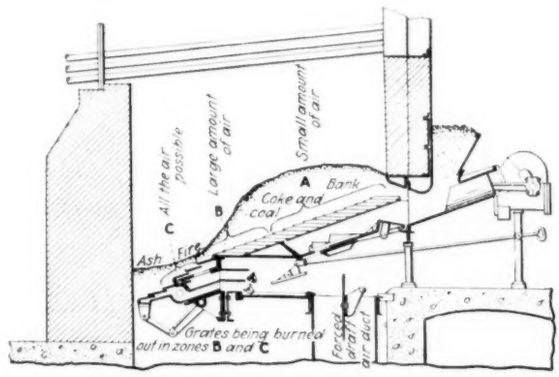


Fig. 1—Plan of air distribution used by Fireman No. 1

In addition, the fundamental theory of the underfeed stoker provides that the fuel bed shall consist of an incandescent upper layer of fuel beneath which the green

coal is distilled and coked in an oxidizing atmosphere. The hydrocarbons thus formed must burn in an atmosphere rich in oxygen to insure completion of the reaction. It is thus seen that an insufficient supply of air at the point where green fuel is fed to the fire will cause an excessive loss due first, to the coking of the coal in a reducing atmosphere, and second, to the loss of hydrocarbons before their complete conversion to carbon dioxide.

Fireman No. 1, in admitting "all the air possible" at

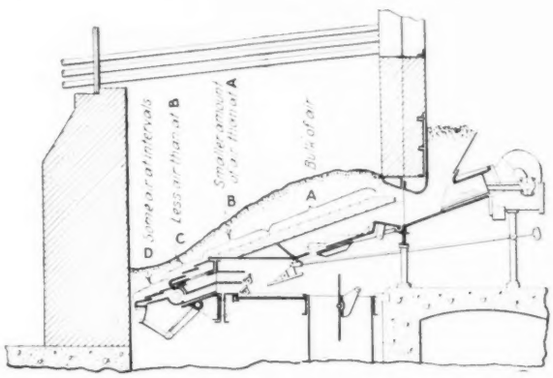


Fig. 2—Plan of air distribution used by Fireman No. 2

point *C* creates an excess air loss due to the cold air passing through a thin fuel bed. This causes rapid burning of the coal, leaving bare grates, which is undoubtedly the cause for the grates burning out. In addition, this large supply of air through the thin section of the fuel bed dilutes the products of combustion above the incandescent layer and carries away considerable heat up the stack.

S. E. Tray, Combustion Engr.,
Battle Creek, Mich. Consumers Power Company.

* * * *

What Would You Do?

THE story "What Would You Do?" which appeared in the June 28 issue, and the letters that have appeared since on the same subject have been of interest to me, and the following account may be worth passing along.

I have been employed for the last few years as chief engineer by a concern which recently decided to revamp its power plant. The plant consisted of a 250 hp. simple Corliss engine running at 80 r.p.m. and a 9 x 10-in. slide-valve engine direct connected to a direct current generator used for lighting and charging batteries. The flywheel of the main engine is grooved for a rope drive.

Old methods of producing our products had to be discarded for new, for competition was keen, therefore it was a case of classifiers, settling tanks, filtration, driers, and mills. In order to make these operations flexible, it was decided to electrify the plant. The problem confronting us at the time was: Should we install a new generating unit capable of taking care of the whole plant, and the anticipated future growth, or should we install a unit capable of handling the present electric power needed and later on duplicate the unit, or should we buy public service power? It was finally decided to take the path of least resistance and go over to public service power. As the load had decreased on the main engine, the boiler requirements became such that we cut out one boiler.

Now it will be evident to the readers of *Power*, that the engineers were confronted with a problem. Until such time as the firm might decide to install electrical equipment, the engineers had to find some other outlet for their usefulness. The superintendent of the factory put the question up to me. He said:

"We have in the factory many dollars worth of machinery that requires skilled help to oversee. As you know, our power requirements in the engine room and the boiler room are decreasing and it really does not require as much of your attention as before. Now it seems that you can take charge of the machinery inside the factory. By so doing you will enhance your value to the concern, also keep intact with the organization for future use."

The problem was brought to a head. Could we as engineers adapt ourselves to conditions inside the plant. What would you do? The answer to that is one of adaptability. Since the first of the year the engineers have had charge of 7 centrifugal pumps, 7 induction motors, 2 diaphragm pumps, 1 filter and 1 drier to the complete satisfaction of the management. The knowledge gained through years of steam engineering has come in handy for the upkeep and operation of this machinery. A few months ago one of the driers was changed over from coal to oil burning, and the engineers took over the operation of the oil burners. At the present time the other two driers are being changed over, and the engineers will take them in charge also.

The tale of "what would you do" is in this particular case completed. The answer to it in our case was adaptability. The training that I have had during my experience as a steam engineer has fitted me for any kind of work that might confront me inside of any factory, and this would apply to thousands of other engineers. It may be contended that the work does not tend to elevate the profession of stationary engineering, but there is no disgrace in honest labor. There is no disgrace in going over from generating pounds of steam and kilowatts to that of producing tonnage per hour.

I hope that these few remarks may be helpful to other readers who may be confronted with a similar situation. If there is the right stuff in a man, he will roll up his sleeves and show his superiors that their confidence is not misplaced.

G. T. Micheals.
New York City.

* * * *

Fallacy of Measuring Boiler Output by Feed-Water Input

I SHOULD like to take exception to some of the statements made by F. V. Wetherill in his article, "Fallacy of Measuring Boiler Output by Feed-Water Input," which appeared in the Aug. 2 issue. Not that I entirely disagree with him, but because his letter reads like that of a theorist!

Personally, I am inclined to agree with the "quite a few plant operators who believe it is sufficient to measure the feed-water input." The plant owners do not give a whoop how much steam is generated, how it is generated or how it is delivered. They are interested in but two items—the cost of power at the point of consumption and the cost of steam per thousand pounds at the point of consumption.

This cost includes coal, labor, water, maintenance,

fixed charges and miscellaneous items such as oil, waste, etc. Obviously, blowdown and safety-valve losses are a waste of both coal and water. Losses in an average plant through the safety valve are not large enough to be considered, but with treated water the blowdown losses in heat and water may be a considerable item during a period of a year.

The chief value of measuring water input to the boilers is in the check it gives to the complete plant. The majority of us know, some by name as the Parsons line, some by experience, that there is a definite, straight-line variation between the coal consumption and the output of the plant. If you measure the steam output, you get only part of the story; if you measure the water, you get it all. If your coal ratio runs high gradually and consistently, the chances are it is because of poor operation or inefficiency of the boilers, turbine or process; probably in one of the last two, as poor boiler operation is a little more evident and easier to check. If the ratio varies suddenly and erratically, the chances are that the fireman is not on the job or the blowdown is excessive.

This cannot always be relied upon though. At one plant we paid the firemen a bonus on the gross evaporation. Each blowdown showed on the feed-water chart and there was little chance of cheating. The boiler room was washed down each night by the night fireman with a 2-in. hose with a 1-in. nipple for a nozzle. One night I was down because of some turbine trouble and happened to be up on one of the boilers inspecting some insulation when the night man came on shift. He immediately opened up the valve on the wash line and let it run as he washed down between his other duties. I noticed it was hot and tracing back found he had changed the hose from the service water line to the feed line. Next morning I went down some time before it was time to change watch and the hose was still running. We got a new fireman, but he was never able to make as good a bonus as the old one did.

As a rule, however, blowdown is rather constant, and if a definite amount is blown down in the glass at regular intervals, it can be closely approximated so that the water measurements can be used to give a good check on the steam actually generated.

Now I am not trying to belittle the steam-flow meter. In my own plant I would have one on each boiler in preference to a feed-water meter, provided I could not have both, of course. If I could not do this, I would do as I did recently—have an orifice installed in both the feed-water and steam lines and the meter body with a chart graduated 1 to 100, connected so that it could be used on either line.

I mentioned a steam meter in my own plant for the reason that I would not give a whoop for flow-meter readings from any other plant except in a relative way. I have every confidence in my own meters, and my experience goes back almost ten years.

The average engineer knows nothing and cares nothing about the meter except to take the readings as gospel truth. Not long ago, in looking over the records of one plant equipped with both steam and water meters, I found the blowdown to be almost 36 per cent of the total water used. Obviously, something was wrong, yet that report was going into the office each day to the manager who, fortunately for the engineer, was a chemist who knew nothing about power plants. As the plant was a new one, and the cost of operation was about half what it was with the old one, he saw no reason for finding fault.

Recently, the N.E.L.A. made an investigation on 210 flow-meter installations and reported eleven causes of operating trouble and nine methods of improper installations causing inaccuracies. To one familiar with flow-meters and their installations, these 20 items appear childish, yet they are actual difficulties encountered, not by us poor dubs of industrial-plant engineers, but by operators in central stations who are supposed to know better or at least have expert supervision.

One company reported, "Due to the liability of errors in the installation and sometimes in the design of flow meters it appears advisable to check them by means of a weighed water test in addition to the usual water-column test," and "in view of our operating experiences, with wide variations between the readings of various makes of meters connected to a common differential producing device, it is interesting to speculate as to the manner of measuring the boiler feed water for long periods of time in plants reporting unusually high boiler efficiency. In some of these cases it would appear that remarkable boiler performances are sometimes indicated at the expense of the station water rate.

"The use of flow meters in central stations is practically universal, but it requires the close co-operation of manufacturers and users to satisfy the ever-increasing demand for greater accuracy."

In other words, they are worth while having around for their relative results, but are not to be depended upon. By this I do not mean, and I am sure the N.E.L.A. committee did not mean, that they could not be made accurate, but that the average commercial installation is not entirely dependable, through no fault of the meter perhaps, but because of its installation or maintenance.

Reported tests on 27 recorders in the same report show maximum errors of 17 per cent. Only one test out of a possible 100 was accurate, the average error being about 4 per cent. Integrators were not so bad and an average of about 35 tests on 12 meters was only about 3 per cent.

Mr. Wetherill gives us some details of an installation that is saving $17 a day. I do not doubt that that amount could be saved, but I do maintain that the operation of the plant before the installation was not up to scratch and that six months after the installation they will be back to the same old rut.

What they needed was not so much a flow meter as an engineer. At $4.25 a ton $17 means 4 tons of coal. In a plant burning 100 tons a day, and that is a good-sized industrial plant, four tons saving would mean boosting the boiler efficiency from about 70 to 73 per cent, and the plant that can save 3 per cent by the installation of a flow meter is not being operated properly. A competent engineer can tell when excessive peaks come on the boilers by half a dozen different ways and takes steps to smooth out the load. Of course the steam meter offers refinements and makes this easier, but does not the water meter do the same thing almost as well.

Personally, I would not be without a steam-flow meter if I had to make it myself, but in another plant I would not even allow them money for charts unless they had an instrument man to take care of it and a chief who would use the records. Furthermore, when a $200 or $300 piece of apparatus boosts a boiler-room efficiency 3 per cent, it is, in my opinion, time to fire the engineer.

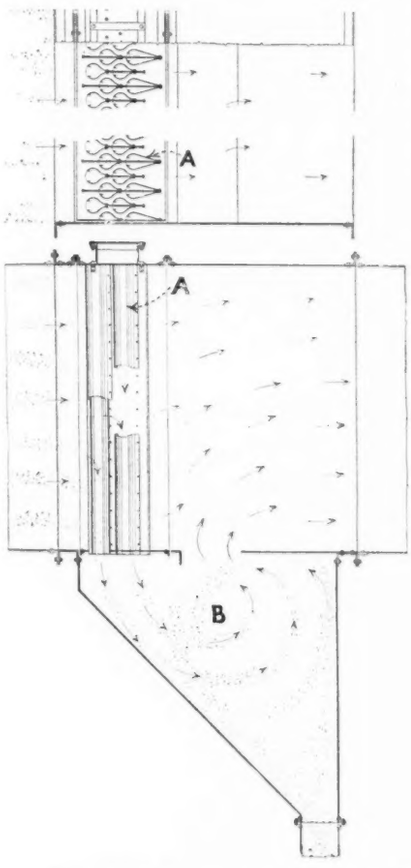
Los Angeles, Calif. B. MARKER.

New and Improved EQUIPMENT

Green Cindertrap for Boiler Gases

A DEVICE for separating the cinders from flue gas, developed recently by the Green Fuel Economizer Company, Beacon, N. Y., is illustrated.

It consists essentially of a battery of elements set vertically and arranged in staggered double rows, mounted in a



Details of cindertrap showing path of gases and collecting hopper

frame or casing ready for installation in a horizontal portion of the smoke flue. The unit is placed above a bin or hopper of special shape and design, into which the lower ends of the trap element *A* project.

Referring to the illustration and noting the direction of the gas flow, it will be seen that the gases are required to make abrupt changes in direction in passing through the unit, and in so doing the cinders are trapped in the vertical elements *A* and drop into the hopper *B* below. A small volume of gas passes downward with the cinders into the hopper, where it separates and again returns to the main duct. The main body of the gases passes directly through the unit.

The unit is designed to fit into space that would otherwise be taken up by the flue, so that no additional space is required for installation.

It is claimed by the manufacturer that the draft loss is low, being less than 0.2, and that this can be controlled to a considerable extent by designing for low gas velocity. It is also pointed out that no water is used in connection with the operation, and that, owing to the low gas velocity, the abrasive action of the cinders is reduced to a minimum.

Kelly Neway Gate Valves

SELF-CLEANING seats, valve disks protected when valves are wide open, valve pockets eliminated by use of self-aligning wedges on side walls and

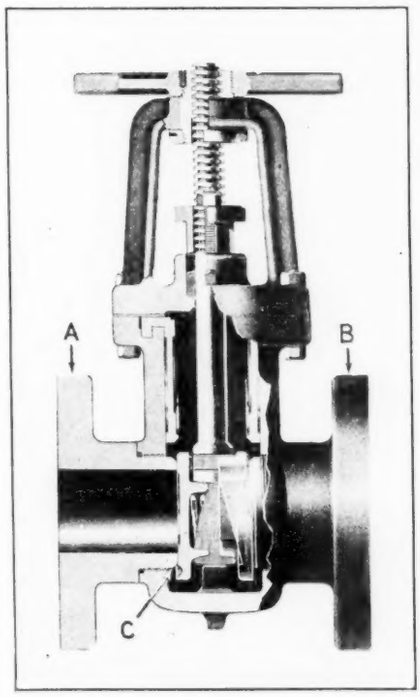


Fig. 1—Cut-away view of valve with flanged inserts

standard body with detachable inserts and seats permitting ten different service combinations for the one valve, are some of the novel features of construction of the Neway gate valve, recently developed by the Kelly Company, 140 South Dearborn St., Chicago. It is intended as a general all-purpose valve for steam, water, gas and oil for steam pressures up to 300 lb. and water pressures of 450 lb., in sizes ranging from 2 to 12 in. In the near future it is the intention to standardize for higher pressures and for larger sizes.

As indicated in the sectional view,

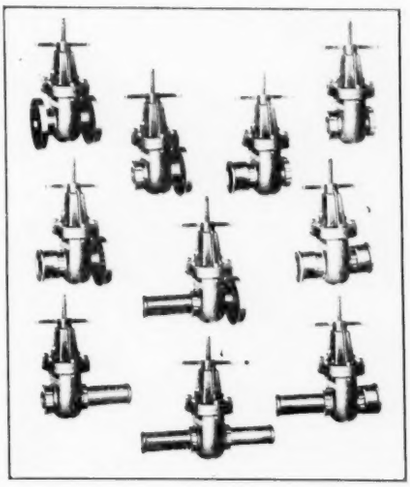


Fig. 2—Ten service combinations with standard body and interchangeable inserts of screw, flange, hub and spigot types

Fig. 1, the valve is of the outside screw-and-yoke type using a tee handle to give large leverage, instead of the usual wheel. An outstanding feature is the use of a standard body to which interchangeable inserts of screw, flange, hub and spigot types may be screwed or bolted to give the ten different service combinations shown in Fig. 2. The face-to-face measurements of the flanged valves correspond to A.S.M.E. standard dimensions. On the ends of these inserts, as *A* and *B* Fig. 1, bronze or monel metal rings are cast integral to form the valve seats as at *C*, with ample provision for refacing. When the valve is assembled, these rings come within the body so that they are not subjected to crushing action from the body, owing to the difference in expansion between the two metals, and the leakage that ordinarily would result at the joints.

The valve proper consists of two parallel disks, each being forced against the ring seat on its respective side by central, self-aligning, tapered wedges that fit loosely into tee slots on either side of the valve body. These wedges

have vertical stems by means of which they can be removed readily from the body when the bonnet has been detached. Between the two disks at the top a recess is provided to receive a grooved shoulder at the base of the valve stem.

To guard the disks when the valve is open, protecting plates have been suspended on the upper walls of the body. Slots at the sides guide them, and lug hooks at the top hold them in place. On the face of each plate is a circular machined surface to correspond with that on the valve disk. Around the lower periphery is a semicircular V-shaped ridge whose function it is to scrape off any accumulation of sediment on the disk as the valve rises to the full-open position. Around the lower half of the disk there is a corresponding V-groove whose outer wall projects beyond the surface of the disk to form a cleaning edge that sweeps over the valve seat. When the valve is opening or closing, the projecting ridges hold the machined surface of the disk at a uniform distance from the seat, eliminating uneven wear, wiredrawing or scoring of the surface. At the upper limit of travel the ridge on the plate and the groove in the disk coincide. This permits a compressed spiral spring between the two disks to bring the machined surfaces of disk and plate into intimate contact, so that the former is fully protected while the valve remains in the wide-open position.

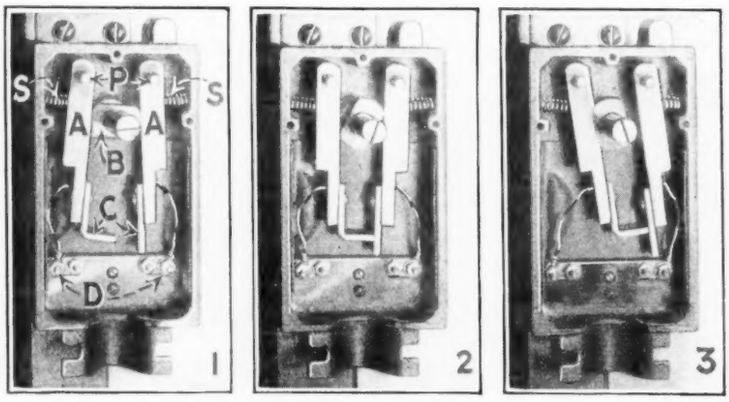
Interlock Switch for Use on Elevator Doors

RECORDS show that most of the fatal accidents in the operation of freight and passenger elevators happen at the landing doors. Such accidents can be practically eliminated by installing interlock switches on these doors, to prevent the car being started until the doors are closed and locked. This assertion is proved by the accident records of states where the installation of door interlocks is made mandatory by law. In these states the fatal accidents are only a small percentage of what they are in the states where interlocks are not compulsory.

An interlock switch on an elevator landing door is subject to severe conditions of constant use, jar and dirt. It must be designed for use in small space and must be practically 100 per cent reliable in operation. Failure of the switch to function properly, causes the elevator to be shut down, and this leads to permanently short-circuiting the switch—a hazardous practice.

A great many types of elevator-door interlock switches have been devised. One of the latest is that put on the market by Franz A. Boedtcher, 442 W. 42nd St., New York City. Three positions of the switch are shown in Figs. 1 to 3. The switch consists of two Bakelite arms *A* supported at their upper ends by pins *P*, which are carried in bearings in the front and rear of the switchbox. On their lower ends these arms have copper-bar contacts *C*, which are connected to binding posts *D* by flexible copper shunts, therefore there are no moving joints in the electrical circuit.

The switch is closed by springs *S* and is opened by a cam *B*. In Fig. 1 the switch is shown in the open position.



Figs. 1 to 3—Interlock switch shown in three positions

To close the switch, cam *B* is turned, and when it reaches the position shown in Fig. 2, the contacts just touch. The closing operation is completed by turning the cam to the position shown in Fig. 3. By making one of the springs in the switch stronger than the other, the two switch arms are swung sidewise by the heavier spring, as in Fig. 3. This motion causes the left-hand contact to slide on the right-hand one and insures a good wiping connection between the two. Also the operating contact is in a different position from that where the circuit is made and broken. When opening, the operations are the reverse of those described. The contacts first slide from the position in Fig. 3 to that in Fig. 2 and then are opened to the position in Fig. 1. This gives a wiping contact when opening as well as when closing the switch.

The cover on the switch case is made in two parts. The top half carries the outboard bearing of the camshaft, so that this shaft is substantially mounted. The upper half of the switch-box cover also supports the outboard bearings for the switch arms, consequently the switch is held rigidly in alignment. As the switch-arms are carried in metal bearings, there is practically no wear on the moving parts. The lower half of the switch case can be removed to allow inspection of the contacts.

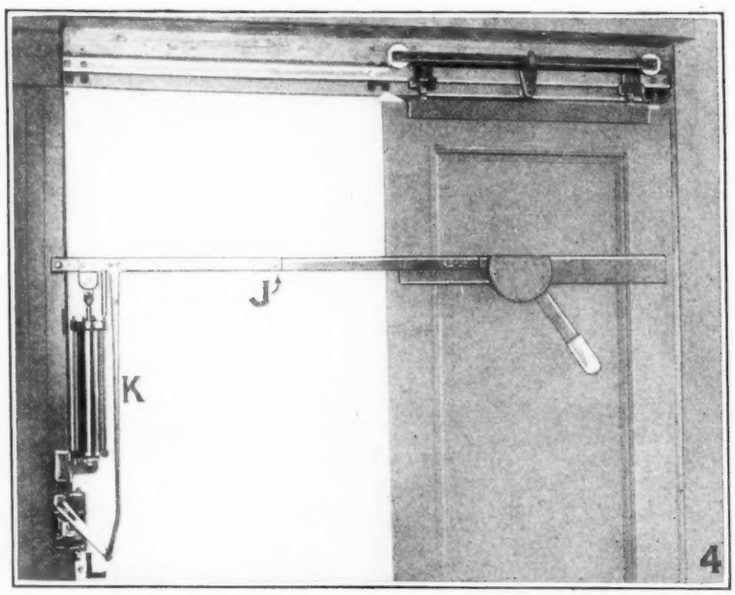


Fig. 4—Interlock switch mounted on elevator landing door

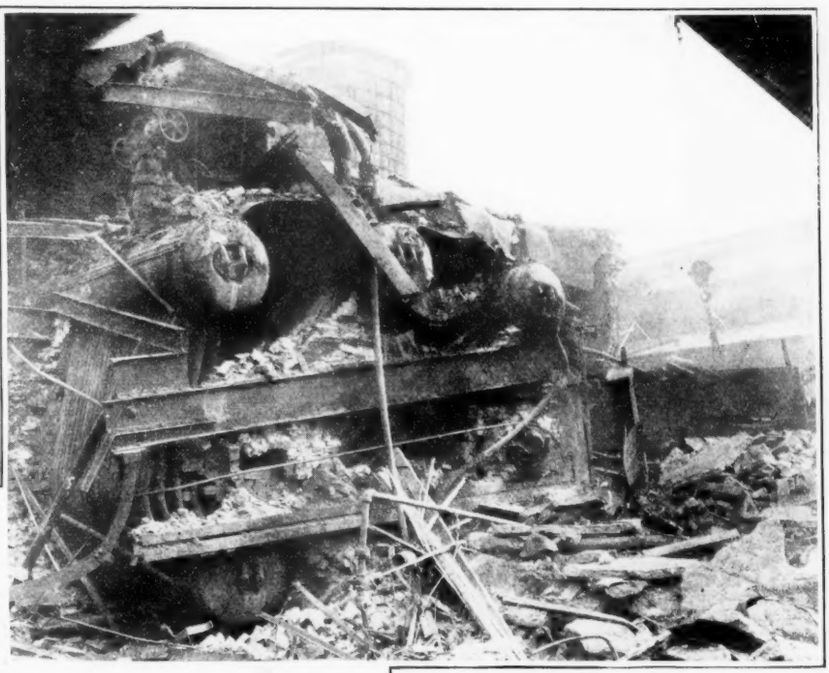
One of these switches mounted on an elevator landing door is shown in Fig. 4. The operating lever *L* on the switch is connected by a link *K* to the operating bar on the door. When the door is opened, the operating bar knuckles upward at joint *J* and, in so doing, raises *L* and opens the interlock switch. In closing the reverse operation takes place as previously explained.

Explosion Wrecks Boiler Room

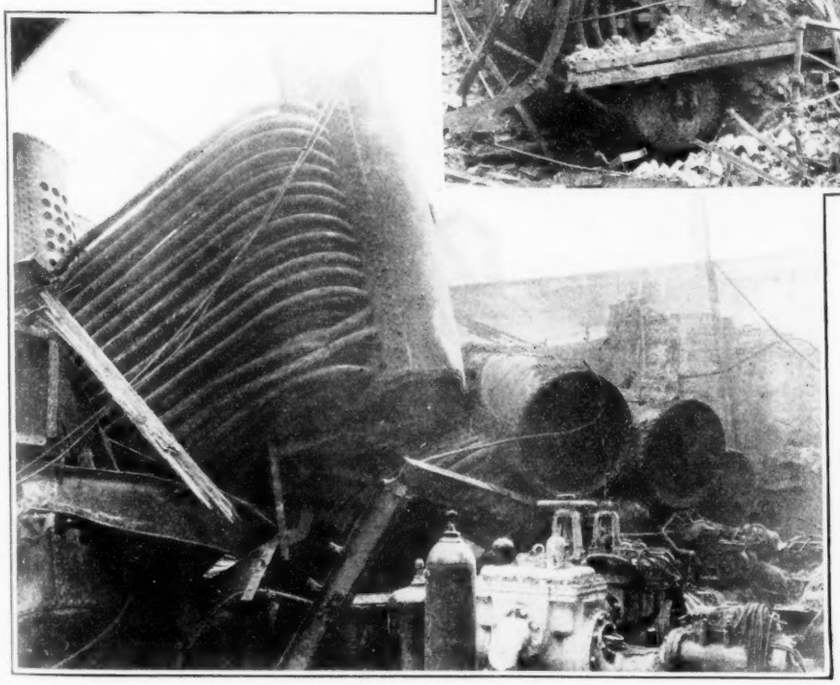
Head of Mud Drum Lets Go Owing to Corrosion and Grooving at the Heel of the Flange

ON THE morning of Oct. 31, at 1:30, the explosion of a Stirling boiler, left the boiler house of the Austin Manufacturing Company, of Harvey, Ill., a tangled mass of ruins. One of the two men in the plant at that time was scalded badly enough to be sent to the hospital for three days, and the property damage approximated $50,000.

The boiler plant contained four four-drum Stirling boilers, three having 2,930 sq.ft. of surface each, served by traveling grates, and the other a hand-fired boiler of 1,500 sq.ft. All were set singly and arranged in a single row facing south. The smaller boiler, No. 1, was at the west end of the room near the engine-room wall. A passage way intervened and then came boilers Nos. 2, 3 and 4 in close proximity. The boilers supplied steam to the hammer shop, two turbines, an engine, two air compressors and a fire pump.



Boilers Nos. 3 and 4 at the other end of the boiler room



Boilers Nos. 1 and 2 after explosion; damaged mud drum at center of photograph

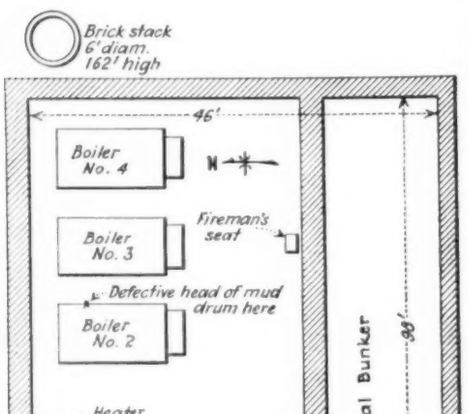
All the boilers had been designed for a working pressure of 160 lb., but the safety valves were set to blow at 155 lb., so that an operating pressure of 150 lb. could be maintained. No. 2 boiler, the one that exploded, had been installed in 1910; the others from 1913 to 1918.

During the night of the accident only No. 2 boiler was in operation, carrying the usual small night load and, as shown by a recording gage in the engine room, maintained a pressure close to the 150-lb. line. Ordinarily, automatic damper regulators, operated by compressed air, controlled the pressure on the boilers, but at night, with no other use for compressed air, it had been the custom to shut down the compressor and regulate by hand. Just prior to the accident a warning sizzle from the two safety valves on the boiler, had caused the fireman to shut down the stoker and close the damper by means of a handwheel at the front of the setting. He had no sooner returned to his seat, about 20 ft. distant, when the boiler let go.

The cause was the failure of the blind head of the mud drum, that is, the head opposite the one containing the manhole. At the seat of the flange, the head had ruptured all the way around, with the exception of a narrow strip of metal that, acting as a hinge, forced the head to swing outward through an angle of 180 deg. and remain hanging to the drum. The force of the out-rushing steam pushed boilers Nos. 3 and 4 to the east and demolished their settings. The reaction to the steam flow caused the damaged boiler to hurtle across the passageway and unseat boiler No. 1. With the reactive force on the undamaged head of the bottom drum the lower portion of the boiler naturally swung outward, so that when it came to rest, the drums were vertical, with the damaged head at the lower end. The force

of the explosion also caused the roof and the brick walls of the boiler house and much of the engine-room dividing wall to collapse.

Leading up to the cause of the accident, mention should be made of the boiler feed water, which originally and up to 1924 had been raised by an air lift from a well 1,350 ft. deep. The water contained as high as 91 grains per gallon of total solids and was strongly acid. Although the water always had been treated, the loss of tubes was excessive and by 1924 the internal corrosion and pitting action on the plates became so pronounced that an extended investigation was made, including drilling of the shell plate of No. 4 boiler at the worst spot, so that the micrometer might be used to measure the thickness of the metal. No. 2 boiler was inspected thoroughly but no drillings were made. The findings showed such serious conditions that to check farther deterioration, a change of feed to city water from Lake Michigan was recommended and adopted. The usual semi-annual inspections from that date indicated that the pitting action had been arrested. Scale formation had been reduced to a minimum, as even the lake water was being softened, so that anything like a dangerous crack should have been detected. After the accident it was stated that the period of inspection had just arrived and there had been time to look over all the boilers except No. 2. It is obvious that an internal inspection of this boiler would have revealed the dangerous condition of the head.

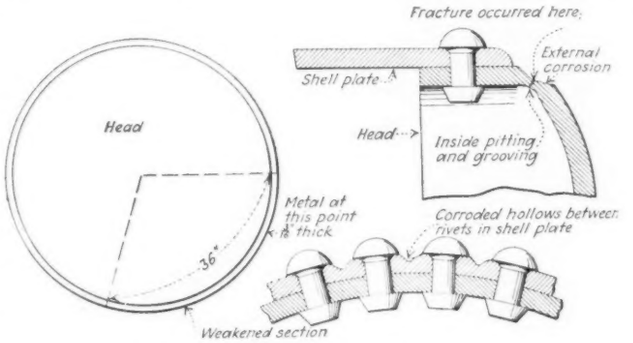


Sketch showing layout of boiler room

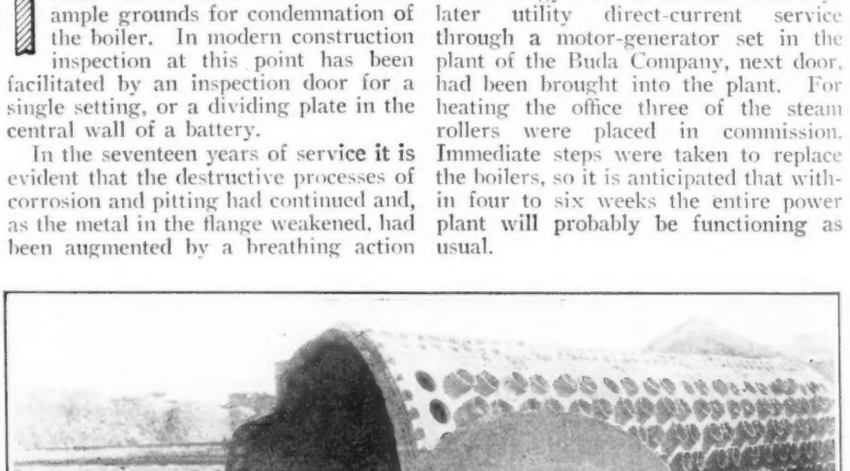
Measurements of the damaged drum showed a diameter of 42 in. and original metal thicknesses of $\frac{13}{16}$ in. for the tube sheet, $\frac{7}{8}$ in. for the bottom sheet and $\frac{1}{2}$ in. for the damaged head. Inspection of the fracture and the head showed that for a distance of 36 in. from the front lap seam down, or practically the lower, front quarter of the circumference, there was evidence of considerable external corrosion on the heel of the flange and decided internal pitting and grooving, so that the metal at the thinnest point, had been reduced to $\frac{3}{16}$ in. Between the rivets on the lower shell plate in this area, the outer surface of the metal had been hollowed away to a depth of one-eighth inch. In accordance with the practice at the time of installation the blind head of the mud drum had been incased in the brickwork of the side wall, and unfortunately, so far as known, this brickwork had never been removed at any one of the numerous inspections made on this boiler. If it had been, the external condition of the metal plus the deterioration of the inner surface would have furnished ample grounds for condemnation of the boiler. In modern construction inspection at this point has been facilitated by an inspection door for a single setting, or a dividing plate in the central wall of a battery.

In the seventeen years of service it is evident that the destructive processes of corrosion and pitting had continued and, as the metal in the flange weakened, had been augmented by a breathing action that would come with every change in pressure and temperature, particularly in a head of less dish than modern standards require. It is probable that this latter action hurried the development of a crack, and eventually a rupture in the weakened section.

With the entire boiler room demolished and the generating room out of commission for lack of steam, the management showed great enterprise by restoring service in part within a few hours. The firm had on the premises a number of gasoline-engine-driven rollers and a few steam rollers. By noon of the same day as the accident three of these gasoline engines were belted to generators on the usual testing floor and approximately 100 kw. of electrical energy made available. Two days later utility direct-current service through a motor-generator set in the plant of the Buda Company, next door, had been brought into the plant. For heating the office three of the steam rollers were placed in commission. Immediate steps were taken to replace the boilers, so it is anticipated that within four to six weeks the entire power plant will probably be functioning as usual.



Details showing weakened section



Damaged head after tubes had been cut and drum placed out in yard

Operation of Relief Valves in Hydro-Electric Plants

WATER HAMMER in penstocks and pipe lines has been the cause of a number of disastrous failures in these parts of hydro-electric plants. Waterwheel regulation, the head under which they operate, the use of relief valves and surge tanks all have a bearing on the excess pressure that may be caused by water hammer. The Hydraulic Power Committee of the National Electric Light Association has recently issued a report on the "Effects of Speed Regulation and Water Hammer on the Design of Relief Valves, Penstocks, and Surge Tanks," which discusses these subjects in a comprehensive manner, and this article is an abstract of the section of this report dealing with relief valves.

IN GENERAL the term "relief valve" may be taken to include several devices used in connection with hydraulic prime movers to divert the water from the runner at times of sudden load rejection. Two general methods are possible, one diverting the water from the wheel without changing the rate of flow through the penstock, the other involving a change in the rate of flow.

In the first method three types of mechanism have been used to vary the quantity of water impinging on the buckets of a tangential wheel. The oldest form is the deflecting nozzle, which is connected to the penstock through a ball joint and supported at its free end by a piston operated from a power cylinder under control of the governor. By this means the nozzle can be lowered so that the jet misses the buckets entirely or can be raised to furnish the necessary supply of water required to meet the power demand. Difficulties in keeping the ball joint watertight have led to the discontinuance of this type.

The second device, also now obsolete, is the cutoff hood which is placed in front of a fixed nozzle. It is swung on a fulcrum in front of the nozzle and has been made in various shapes. It is moved into the jet under control of the governor, cutting off the stream from the wheel.

The third device is the jet deflector or stream bender, which is mounted in the same manner as the cutoff hood and which moves into the stream and deflects the jet from the wheel under the action of the governor. The latest device of this nature consists of a circular ring or sleeve with a renewable liner, the ring being so mounted that the jet passes through it at all times. A small angle of deflection causes the jet to miss the buckets and pass out into the tailrace.

Using Stream Deflectors

With impulse wheels using stream deflectors or deflecting nozzles, the problem of water hammer in the penstocks due to governor action does not enter, because there is no change in the rate of flow to cause a pressure rise. In general, the moving parts are relatively light and easy to move, and governors may therefore be set to operate with a very fast stroke. It is not uncommon to specify a full governor stroke in one second with this class of equipment, and under these conditions the speed rise may be held to a very low percentage of the normal speed.

These devices are not in themselves water saving, it being necessary for the operator to close the needle nozzle to accomplish this purpose. In order to make action automatic and more rapid, the governor may be connected to the main power needle, operating it to supply only the quantity of water required to suit the load. In many instances such operation might result in abnormal increase in penstock pressure. Two general methods for preventing this pressure rise have been developed, the first employing either a relief nozzle or a relief valve and the second a jet deflector.

Reaction-Type Turbines

Two general types of relief valves are in use for reaction turbines, the governor-operated type and the type which operates due to pressure rise in the penstock. One of the first type is a direct-connected governor-operated synchronous relief valve, which opens inversely with the closure of the turbine gates and which then closes slowly due to its own weight, assisted, if necessary, by springs or a hydraulic piston, the time of closing being regulated by an oil-filled dashpot with adjustable bypass ports. In principle this type is identical with that used on tangential wheels. In the smaller sizes it is possible to use the power mechanism of the governor to actuate the valve, but in the larger sizes the main relief valve is hydraulically operated by penstock pressure, the pressure control valve being mechanically connected to the governing mechanism through an oil-filled dashpot. This reduces the governor effort required, as it would otherwise be necessary to have sufficient pressure oil to lift the entire valve. In the event of load demand following rejection with the valve still in the open position, the valve moves inversely with the opening of the turbine gates. This is accomplished directly in the smaller valves, and in the larger types through the direct-connected dashpot acting on the pilot valve.

Pressure Operated Type

In the second, or pressure-operated type the control mechanism is actuated by means of the increased pressure acting on a small piston. In the floating-lever type the dashpot end of the lever is actuated by this "manometrical device" instead of by the governor, the other operations of the valve being similar to the governor-operated type. The pressure-actuated control cannot be of the ordinary pop-valve type for it would be slammed shut when there is normal or subnormal pressure in the penstock. The closing motion of the control mechanism is therefore under dashpot action.

A second type of pressure-actuated relief valve is held closed at any desired pressure by compressed air in an auxiliary air chamber. The air is first compressed by the pressure of the penstock, and as it is readily compressed further in the event of a pressure rise in the pipe it offers little resistance to the opening of the relief valve. The installation consists of a standard-type Johnson plunger valve with the usual control mechanism omitted, the plunger being set in reversed position.

Relief valves may be operated in either of two ways—as "synchronous bypass" or "water saving." In the first case the relief valve follows inversely the movement of the turbine gates, that is, as the gates close, the relief valve opens by the same percentage and vice versa. This maintains a constant flow through the penstock and eliminates pressure changes, but is wasteful of water. It may, however, be necessary in a governing plant which must have water available to pick up load without delay. If the flow through the pen-

stock is decreased each time load is reduced, it becomes necessary to again accelerate the water when additional load is demanded. Should the plant have a long penstock, it may be impossible to accelerate the flow with sufficient rapidity to meet the load demand; and if the plant is used for governing, operation of a synchronous bypass becomes necessary.

Where plants have relatively short penstocks or they can operate on block load with governors under the control of load-limiting devices, conditions are ideal for the use of water-saving relief valves. In this case the relief valve is arranged to open practically synchronously with the closure of the turbine gates and then to close gradually and stop the flow of water through the penstock.

Size of Relief Valves

The size or capacity of the relief valve has a direct relation to the length of penstock and an inverse relation to the time of the governor stroke. On a short penstock with a low head the relief valve may be omitted entirely with safety, but with a long penstock it is necessary to have a relief valve capable of passing the maximum flow of water taken by the turbine. Between these limits it is customary practice to use relief valves having from 50 per cent to 80 per cent capacity, provided the pressure rise due to turbine gate closure does not exceed 20 per cent to 25 per cent of the static head.

There is an approximate criterion which states that when the time of governor action is shorter than the length of the penstock in feet times the velocity in the penstock in seconds divided by ten times the head in feet, a relief valve should be installed. This is only an approximate rule, however, and the particular problem should always be thoroughly investigated, balancing the cost of the relief valve against the additional cost of penstock and hydraulic equipment necessary to withstand the increased pressure which would result if the valve is omitted.

Closing Time of Valves

Even if the pressure rise due to closing the turbine gates permits, it is not desirable to effect too rapid a closure of the relief valve. The water-saving type is constructed so that it actually starts to close as soon as it begins to open. The opening stroke of large valves is on the order of two seconds. If the closing stroke is set for a few seconds, the relation of opening to closing time becomes small, and unless the valve is especially designed for such conditions, it will never completely open. Closure is usually effected in from one-half to three minutes, depending upon pressure conditions in the penstock. This time also gives a large relation between opening and closing stroke and permits of practically full opening of the valve upon rejection of full load.

RECENT PUBLICATIONS

MECHANICS OF MATERIALS. By George Young, Jr., Professor of Architecture, Cornell University; and H. E. Baxter, Assistant Professor of Architecture, Cornell University. Published by the Macmillan Company, New York City. Cloth; 5½x8½ in.; 451 pages; price, $4.

This text, intended to serve as an introduction to the study of mechanical construction, presents the theory and facts pertaining to mechanics and design, and little of an empirical nature is given. Physical concepts are given preference over mathematical processes, and graphical methods are used freely. The problems selected for study are such as afford an opportunity for the study of some general principles, and no attempt has been made to select problems from the latest development in structural practice. In the first five chapters the authors discuss forces, equilibrium and stresses. The next few chapters deal with center of gravity, unit stress and deformation. One chapter is devoted to materials. Beams are treated in five chapters in which are discussed unit stresses in bending and in shear, deformation and characteristic beam shapes. In other chapters are discussed columns, eccentric loads and combined stresses, unsymmetric bending, problems involving work, and special graphical methods. But few tables of tabulated data are given, as the authors feel the book will be supplemented by a reference or handbook such as published by the steel companies.

WORTHINGTON PUMP HANDBOOK. By Worthington Engineers. Published by Worthington Pump & Machinery Corporation, New York. Cloth; 6x9 in.; 1,250 pages; price, $1.

The Worthington engineers have prepared in this handbook a reference and text that engineers and students confronted with pump problems should find of great value. It contains not only a large amount of material describing Worthington pumps, but also includes definitions of terms and units common to the pump industry, general pump theory, instruction on the installation and operation of Worthington pumps, and a large amount of useful tabulated data. The book is divided into eight sections. The first deals with general theory and definitions of units and terms. The next four sections discuss centrifugal pumps, power pumps, deep well pumps, power for pumps, and direct-acting steam pumps. In the sixth section are given instructions for the installation and operation of Worthington pumping machinery. Pumping in the petroleum industry is discussed in the seventh section, and the last section contains 37 pages of useful tabulated data. The Worthington Pump & Machinery Corporation is prepared to give this book free to professors of engineering, in recognized colleges, consulting engineers in active practice, and chief engineers in charge of plants using 1,000 hp. or more.

COKE AND BYPRODUCTS IN 1924. By F. G. Tryon and Others. With a Report on The Marketing of Coal Products, by R. S. McBride. Part II —Mineral Resources of the United States, 1924. United States Government Printing Office, Washington, D. C., 1927. 138 pages. Price, 25 cents.

This joint work of the Bureau of Mines and the domestic commerce division of the Bureau of Foreign and Domestic Commerce is a mine of valuable statistics and information for all those having connection with or interest in the coke industry and its products. The tabular matter on production, distribution and prices is complete and well-presented. It is unfortunate, however, that the government's printing policy is such that this matter, long ago largely available in mimeographed form, is only now available as a pamphlet, three years after the fact. The study by Mr. McBride, on the marketing of coal products, breaks new ground. The marketing of coke, gas, ammonia, tar and light oil are fully discussed. It should prove of great value to those contemplating an entry into the coal-processing field as an adjunct of power generation, by helping them to determine the prospective market for any byproducts that are thus produced.

INDEX TO PROCEEDINGS OF THE AMERICAN SOCIETY FOR TESTING MATERIALS. Published by the Society. Cloth or half leather, 5½x9 in.; 224 pages; Price $2.50 for cloth, $3.50 for half leather.

This is the third collective index published by the A.S.T.M. and is an index of the proceedings for the years 1921 to 1925. The proceedings for these years, Vol. 21 to 25, aggregate 8,255 pages. This index contains not only a comprehensive subject index, but also an author index which lists in the case of each name all papers and discussions attributed to him or any committee reports bearing his signature.

This index should be of value to librarians and to those who keep a file of the society's proceedings.

NEWS *of the* FIELD

Private Concern May Compete With City-Owned Plant

That a private power company may enter the corporate limits of a city and retail electric power in competition with the municipally owned and operated power company without a franchise from the city, provided the power company's lines do not cross streets, alleys or public places owned or controlled by the city, has been decided by the Federal District Court of North Carolina.

Action brought by the city of Tarboro, N. C., and declared by attorneys to be without precedent in court records of the country, sought to enjoin the Virginia Electric & Power Company from serving cotton mills and other industries located within the limits of the City of Tarboro.

The mills, disssatisfied with the undependable service rendered by the municipal plant and the high rates charged for power, entered contract with the Virginia company for their supplies of motive power.

Conditions were such that the power company was able to construct its lines into Tarboro entirely over private property and without crossing any streets or alleys. The first lines were built two years ago. Recently, additional mills sought power contracts with the Virginia company, and it was to block further extensions that an injunction was obtained in the state courts against the power company.

The power company transferred the case to the federal court and Judge I. M. Meekins, in dissolving the enjoining order, ruled that the power company needed no franchise to do business in Tarboro; that in his opinion it would be a dangerous doctrine to hold that a commodity such as electric power should be withheld from industry and the manufacturer be forced to buy from a municipality whether that service be satisfactory or not. The case may be carried to the higher courts of appeal.

Pipe Welding Among Features of Coming Boston Meeting

Practical applications of welding—not theoretical discussions—will feature the all-day meeting of the Affiliated Technical Societies of Boston to be held Dec. 14.

The speakers will present short papers, illustrated with slides or movies, dealing with the use of welding on a specific job.

Plans are maturing rapidly, but the names of speakers and exact titles of papers will not be definitely known for several weeks. Briefly, however, the subject will be presented in three groups of papers: structural, pipe welding and industrial.

The pipe welding group will include welding of water, gas and steam pipes. Mr. Shand of the Air Reduction Company, recent chairman of the Boston Section, American Welding Society, is in charge of this part of the program.

Potomac Electric Power Co. To Celebrate New Unit

The new 30,000-kw. unit, being installed in the Benning power plant of the Potomac Electric Power Company, of Washington, D. C., will be placed in operation on Nov. 22, materially augmenting the city's power supply.

To celebrate the occasion, the company has arranged a luncheon to be held at the plant, and civic leaders and officials of the company will attend.

A.S.M.E. Celebrates Fiftieth Birthday in 1930

The fiftieth anniversary of the American Society of Mechanical Engineers will be celebrated during the week beginning April 7, 1930. This date marks the anniversary of the organization meeting of the society which was held at Stevens Institute of Technology.

While plans for the proposed celebration have not been entirely completed, the tentative arrangement provides concurrently for an international engineering congress of outstanding nature which will not only mark the achievements of the engineering profession for the last fifty years, but will point the way for future growth and development.

Appeals to Engineers for Louvain Memorial

ENDORSING with enthusiasm the recent proposal of Dr. Edward Dean Adams, honorary member of the Engineering Foundation, that a clock and carillon be donated to the new library of the University of Louvain, Belgium, as a memorial to American engineers who lost their lives in France, the Engineering Foundation, through a specially appointed committee, invites engineers throughout the country to contribute toward a fund of $80,000 necessary for a 4-dial clock, a 3-octave carillon of 36 bells and an endowment for perpetual operation and upkeep.

The committee emphasizes this unique opportunity to share the privilege of setting up this beautiful memorial to the services of their profession and the sacrifices of their fellows in the cause of the allies, as a peculiarly acceptable expression of good will from American engineers to their Belgian friends, as well as a contribution to the promotion of higher learning in Europe, including engineering and the sciences.

Names of the American engineers to be memoralized, so far as they can be learned, will be inscribed on suitable tablets to be placed in the Library tower. The committee desires to obtain the names and records of all of American engineers who died outside of America in any branch of service of their own country or any of its allies, during the World War after 1914.

Contributions of five dollars or more, or any sum which donors feel able to give, may be sent to the Committee on War Memorial to American Engineers at once or not later than 1st February, 1928, at 29 West 39th Street, New York. Checks, drafts or money orders should be made payable to United Engineering Society. Families or friends of engineers for whom the memorial is being created may also participate. The names of all contributors will be recorded in a handsome memorial volume which will be deposited in the Library.

The success of the project is assured, but it is desired that a very large number of engineers participate so that this memorial gift by the engineering societies to the University of Louvain may be truly representative of American engineers.

Inscription on back: Louvain Celebration, June, 1927
—Edward Dean Adams, Delegate.

COMPOSITE EMBLEM WORN BY DR. ADAMS

Recent Applications for Power Projects

The City of Sacramento has filed with the Federal Power Commission an application for a license for its Silver Creek project on the South Fork of American River in Eldorado County, California.

It is planned to develop 160,000 hp. Power is to be developed as an incident to a supply of water for municipal purposes. There will be two main storage reservoirs. The Union Valley reservoir, with 165,000 acre-ft. capacity, will be located on the main fork of Silver Creek where a dam 325 ft. high and 1,625 ft. long will be constructed. The Ice House reservoir will contain 45,000 acre-ft. and will be on the South Fork of Silver Creek.

The Gasconade River Power Company, of Kansas City, Mo., has applied for a preliminary permit covering a project on the Gasconade River near Rich Fountain, Mo., where 4,000 hp. of primary power is available. A permit previously had been issued covering this site to the Central Missouri Power & Light Company, but it expired last June.

A favorable report has been made by the Chief of Engineers in connection with the proposed development on the North River in Washington. The Twin Harbor Land Company is seeking a preliminary permit for a project on which 40,000 hp. can be developed.

The Chief of Engineers also has issued a favorable report in connection with a project of the North Connecticut Power Company on the Connecticut River below Springfield, Mass. The company is seeking a license covering the project which is expected to develop 65,000 horsepower.

C. C. Douglas, Turbine Engineer, Dies

Courtney C. Douglas, engineer in charge of turbine sales, Chicago Office, General Electric Company, died suddenly Oct. 31. Mr. Douglas was born Dec. 27, 1880, at Fontana, on Lake Geneva, Wis. He was graduated from the University of Wisconsin in 1903.

The same year he entered the employ of the General Electric Company, and with his experience in the calculating department and later in installation work, he became closely associated with the early development of the steam turbine. In 1908 he was transferred to the Boston office of the company, where he was placed in charge of construction and three years later, in 1911, was moved to Chicago in charge of turbine sales. For years he has been regarded as one of the best authorities on steam turbines in this territory.

His affiliations were numerous. He was a member of the American Society of Mechanical Engineers, the Western Society of Engineers, the Union League Club and the Oak Park Club.

Being a man of wide activity, Mr. Douglas took a great interest in local civic affairs. On the library board in Oak Park he served several terms and at the time of his death was president of the board.

With his good nature and pleasing personality, making him the life of any activity in which he participated, Mr. Douglas had a host of friends both in and out of the engineering field, who will regret his passing. He is survived by his widow, Henrietta F. Douglas, and his son, Courtney C., aged sixteen.

Standard Gas & Electric Buys Wisconsin Valley System

Acquirement for the Standard Gas & Electric Company system of the properties of the Wisconsin Valley Electric Company and subsidiaries, with headquarters at Wausau, Wis., has been announced.

The territory served comprises the entire valley of the Wisconsin River from Stevens Point on the south to Rhinelander on the north, a distance of about 120 miles. It lies between the territories served by Northern States Power Company on the west and Wisconsin Public Service Corporation on the east, both part of the Standard Gas & Electric Company system.

A total of 25 cities and towns, with combined population of 90,000, are variously supplied with electric, gas and street railway services, the principal communities being Wausau, Stevens Point, Antigo, Merrill and Rhinelander.

The company operates hydro-electric and steam stations with combined generating capacities of 23,946 hp. Interconnection and interchange power contracts with non-affiliated companies also are in effect.

Utility Power Plants' Output Up 5 Per Cent in September

A five per cent increase in the production of electric power by public utility power plants in the United States during September over September production in 1926, is indicated in figures just made public by the Geological Survey, Department of the Interior.

The statistics show that the production for September, 1927, was, in round numbers, 6,560,000,000 kw.-hr. compared with 6,221,000,000 in September, 1926.

The average daily production of electricity by public utility power plants during September is placed at 218,700,000 kw.-hr., about 2 per cent greater than the average output for August.

The Geological Survey states that "the curve of average daily production of electricity indicates that the usual seasonal increase in the demand for electricity which starts each year during the later part of the summer period was well under way during August and September."

Additional 15,000-Kw. Unit for Columbus Electric

The Columbus Electric & Power Company of Columbus, Ga., expects to install an additional unit of 15,000 kw. capacity at the big Bartletts Ferry power plant. Stone & Webster, Inc., of Boston, will have charge of the work.

Press reports state that work will begin on the project within a short time and is expected to be completed within a year at an estimated expenditure of $850,000. The present power house at Bartletts Ferry with the dam and equipment cost approximately $7,500,000. This building will be enlarged to accommodate the new unit.

Steam Power Plant Planned by Alabama Power Co.

Plans for the immediate construction of a steam power plant in Walker County, Ala., to cost $20,000,000 were announced Oct. 29 by President Thomas W. Martin of the Alabama Power Company.

The first unit of the plant to produce 50,000 kw. will be completed by the end of 1928 and will cost $5,000,000. The remaining units will be completed as power demands in the state increase.

The plant will be at the mouth of Baker's Creek, which is near Copeland's Ferry in Walker County.

Refractories Institute Issues Code on Firebrick

The renaissance in the refractories industry takes definite shape in the publication of a report by the classification committee of the American Refractories Institute.

The report is in the form of a set of rules and formulae adopted by the institute and is entitled "Classification of Fire Clay Shapes Other Than Straight Tile." To the layman the title suggests little, but to those identified with refractories procedure in the past, the universal adoption of such a classification code signifies an achievement which marks a turning point in the industry and toward which the institute and its committee have labored. This code definitely places upon a commonly-accepted basis the methods of determining costs of all special firebrick shapes.

Approves Western New York Consolidation

Consolidation of the Niagara, Lockport & Ontario Power Company and the Western New York Utilities Co., Inc. of Batavia into a new company to be known as the Niagara, Lockport & Ontario Power Company, was approved by the Public Service Commission at Albany, Nov. 7.

France Soon to Develop Rhine Power

Work is at last about to be started on the harnessing of the Rhine for power purposes between Basle and Strasbourg. This development will necessitate the construction of a canal between Strasbourg and Kembs, so as to make it possible for barges to proceed the entire way from Rotterdam to Basle instead of finishing their journey, as at present, at Mannheim or Strasbourg.

The concession for the construction of the Kembs power station was granted to the Societe des Forces Motrices du Haut-Rhin by Switzerland about three years ago and by the French government under a law of last July. It lasts for 75 years from the date of completion. The dam is to be constructed at the expense of the French government and under the stipulations of the Treaty of Versailles, which permit it to make use of the Rhine water and execute on the German bank all the works required for the exercise of the right, besides giving it the exclusive right to the power, derived subject to payment to Germany of the value of one-half the power actually produced.

Seven months of the year the flow of the Rhine exceeds 850 cu.m. per second, with a gradient of one m. per km., which represents for each km. utilized some 10,000 hp., or three times that of the Rhone above Lyons. The dam to be built 5½ km. below the Swiss frontier will raise the water level by seven meters on the average. By means of sluices the level of the Rhine will be regulated, and also that of the canal, which is designed for a flow of 850 cu.m. at an average of 0.70 m. per second. This canal will have a length of approximately 7 km.; its depth is to be 7 m., and at the site of the Kembs powerhouse there will be two locks, one of 185 m. and the other of 100 m. in length, with a breadth in each case of 25 m. Below the station the canal will rejoin the river.

AVERAGE POWER 120,000 HP.

The Kembs station itself will be located at the northern end of the new canal and will take advantage of a fall of water of some eleven meters to operate turbines, and its average power will be 120,000 hp. The average monthly output will approximate 54,000 kw. The current will be sold in the eastern regions, which are estimated to be easily able to absorb it all. As the canal is extended, other power stations will be erected, the present plans embracing eight in all. The Kembs station is to take five years to complete, at a total cost of about $12,000,000.

Installs New Turbine

The Poplar Bluff, Mo., municipal light plant has installed a new turbine with a capacity of 1,250 kw.

The unit will replace two old-style steam turbines, purchased in 1916 at a cost of $19,000. The city plant in 1922 installed a 625-kw. turbine and this will be maintained as an emergency unit.

Canada Rapidly Increasing Electrical Apparatus

Production of electrical apparatus and supplies in Canada during 1926 amounted in value to $69,767,308, according to the report of the Dominion Bureau of Statistics, recently issued. This output was the greatest recorded for this industry and exceeded by 16 per cent. the previous high record of $60,158,837 established in 1925.

The electrical apparatus industry has shown constant expansion over the last five years in capital employed, number of employees, and in the value of production. In 1922 the number of plants was 101 and they employed a capital of $62,436,282 while the selling value of products was $41,208,368. In each year there have been increases, the corresponding figures for 1926 being: Number of plants, 132; capital employed, $80,323,534; selling value of products, $69,767,308. Ontario leads in electrical apparatus manufacturing, with 98 plants, followed by Quebec with 19; Manitoba 6; British Columbia 5; and Alberta 4.

Obituary

GERARD ALBERT MUNTZ, originator of Muntz metal much used in power plant apparatus, died Oct. 22. Mr. Muntz' life was given to research work in connection with non-ferrous metals. He was an internationally recognized authority on their corrosion, especially that of condenser tubes.

Personal Mention

H. W. MORGAN, formerly mechanical research engineer for the Pittsburgh Coal Company, is now engaged as sales engineer by that company.

IRVING WEED, member of the A.S.M.E. and consulting engineer specializing in public utility valuation, has opened an office at 82 Lafayette Ave., Brooklyn, N. Y.

GEORGE J. JOHNS has left the employ of the Union Gas & Electric Company, Cincinnati, as test engineer, to become assistant electrical engineer for the Associated Gas & Electric Company, Oneonta, N. Y.

C. K. BENNETT, of Tulsa, Okla., and formerly heat transfer expert for the Schutte & Koerting Company, has joined the O. E. Frank Heater & Engineering Company, and is now located at the home office in Buffalo, N. Y.

J. B. RAWLINGS, electrical engineer and member of the New York bar, is now connected with the Western Electric Company as patent attorney. Mr. Rawlings was formerly associated with the Bureau of Standards, Washington, D. C.

E. K. KARCHER was appointed Nov. 1 distribution engineer for the New York Power & Light Corporation, Albany, N. Y. For the last eight years Mr. Karcher served with the Utica Gas & Electric Company, since 1925 as chief electrical engineer.

JAN A. VANDERPOLL, member of A.I.E.E., associated with the Westinghouse Electric Internacional, S. A., Buenos Aires, has been appointed member of the Argentine commissions for the reglementation of installations and watt-hour meters.

C. D. ZIMMERMAN recently resigned as production engineer, steam department, of the Cleveland Electric Illuminating Company, to accept the position of Eastern service manager of the Consolidation Coal Company, with headquarters in New York.

STANLEY BROWN has recently joined Stone & Webster, Inc., as an engineer in the electrical division. Mr. Brown, formerly with McClellan & Junkersfeld, Inc., and Dwight P. Robinson & Company, Inc., of New York, has had a varied experience in electrical design and construction work.

NORMAN W. CALVERT, who for the last thirteen years has been connected with the central heating department of The Detroit Edison Company, has severed his connection with that company to become associated with Klipfel Manufacturing Company, manufacturerrs of automatic valve specialties, at 2641-59 West Harrison St., Chicago.

FREDERICK G. HUGHES, vice-president of the New Departure Manufacturing Company, Bristol, Conn., and for a number of years active in the work of the American Society for Steel Treating, has been nominated for the presidency of that society for 1928. During the last year Mr. Hughes was vice-president of the society and prior to that served as director for two years.

E. C. DEAL, who became vice-president and general manager of the Peoples Light & Power Corporation early this year, has been elected president of the corporation and the twenty-one subsidiaries through which it operates in sixteen states. Mr. Deal began his career in public utilities with what is now the Georgia Railway & Power Company of Atlanta, Ga. He has been connected with operating and management companies in the field, including Stone & Webster, J. G. White Management Corporation, Electric Bond & Share Company and Federal Light & Traction Company.

Society Affairs

DETROIT ENGINEERING SOCIETY, Nov. 16, 478 West Alexandrine Ave., Detroit, "Application of Engineering Principles to the Purchase of Materials and Equipment," by Professor C. F. Hirshfeld, research division of the Detroit Edison Company.

AMERICAN SOCIETY FOR STEEL TREATING, Rhode Island Chapter, 8 p.m., Nov. 16, at Engineering Laboratory, Brown University, "Various Methods for Testing Materials," illustrated lecture, by Prof. William H. Kenerson, mechanical engineering, Brown University. Thomas Ray, chairman, Brown University.

A.S.M.E., ONTARIO, Nov. 16, Brantford, Ont., at 8:00 p.m. This will be a Joint Meeting with the Grand Valley Section of the Association of Professional Engineers of Ontario. "Contract Law" by W. G. Hanna, legal department of the Hydro Electric Power Commission of Ontario.

AMERICAN REFRACTORIES INSTITUTE will hold meetings at the Hotel Chase, St. Louis, Mo., Dec. 6-7. Papers of interest will include "Dry Grinding of Refractories," by Mr. J. M. Gallaher, works manager, Clearfield Machine Company, Clearfield, Pa., and "Burning Refractories with Stokers," by Massillon Refractories Company, Massillon, Ohio. Inquiries concerning sessions should be directed to the secretary of the American Refractories Institute, 2202 Oliver Building, Pittsburgh.

A.S.M.E., METROPOLITAN SECTION, Aeronautic and Oil and Gas Power division meeting, Nov. 22, at 8 o'clock in the Engineering Societies Building, 29 West 39th St., New York City. "The Oil Engine and Aeronautics," Commander E. E. Wilson, U. S. N., head of engineering section, Bureau of Aeronautics, Navy Department, Washington, D. C.; "Heavy Oil Engines for Aircraft," D. R. Pye, deputy director of scientific research, British Air Ministry, and "Experiments in Fuel Injection for Aeronautical Engines," W. F. Joachim, National Advisory Committee for Aeronautics.

Business Notes

THE IDEA COMMUTATOR DRESSER COMPANY, Sycamore, Ill., announces that it has added a portable electric blower to its line of electrical machinery maintenance equipment. This blower is for use in blowing dirt out of machines, but by using special attachments it can be converted into a vacuum cleaner.

THE ROLLWAY BEARING COMPANY has opened a sales office at 956 Leader Building, Cleveland. R. D. Faris has been appointed Cleveland district representative.

Coming Conventions

American Boiler Manufacturers Association, winter meeting, Hotel Cleveland, Cleveland, Feb. 7; A. C. Baker, sec., 801 Rockefeller Bldg.

American Engineering Council, annual meeting will be held in Washington, D. C., Jan. 9-11; L. W. Wallace, executive secretary, 26 Jackson Place, N. W., Washington, D. C.

American Institute of Electrical Engineers, Great Lakes District regional meeting at the Hotel Drake, Chicago, Nov. 28-30, Address J. E. Kearns, chairman registration committee, General Electric Company, 230 South Clark St., Chicago.

American Society of Heating & Ventilating Engineers, hold general meeting at Hotel Pennsylvania in New York City, Jan. 23-26; A. V. Hutchinson, sec., 29 W. 39th St., New York.

American Society of Refrigerating Engineers, annual convention in New York, Dec. 5-7; W. H. Ross, sec., 37 W. 39th St., New York City.

American Water Works Association. Annual meeting, Hotel Fairmont, San Francisco, June 11-16; W. M. Niesley, 170 Broadway, New York City.

American Society of Mechanical Engineers, convention during week of New York Power Show, New York City, Dec. 5-10; Calvin Rice, sec., 29 West 39th St., New York City.

Midwest Power Conference and Exhibition, at Chicago, Feb. 14-17; G. E. Pfisterer, sec., 53 West Jackson Blvd., Chicago.

National Association of Practical Refrigerating Engineers. Eighteenth annual convention and educational exhibition in Civic Convention Hall and headquarters Hotel Whitcomb, San Francisco, Calif., Nov. 29 to Dec. 2. H. Fox, 5707 W. Lake St., Chicago, Ill.

National District Heating Association, annual meeting in May; D. L. Gaskill, sec. 112 West 4th St., Greenville, Ohio.

New York Power Show (National Exposition of Power and Mechanical Engineering) will be held at the Grand Central Palace, New York City, Dec. 5-10. Address inquiries to the International Exposition Co., Grand Central Palace.

National Engineers' Beneficial Association, Fifty-third annual convention will be held in Washington, D. C., Feb. 14. Headquarters to be announced hereafter; Albert L. Jones, secretary treasurer, 313 Machinists' Bldg., Washington, D. C.

Power Transmission Association. Annual meeting, Hotel Commodore, New York City, Dec. 7; W. S. Hays, Sec., Drexel Building, Philadelphia.

THE MORSE CHAIN COMPANY announces the appointment of Harry E. Matthews, as manager of the Charlotte, N. C., office. The managership in that branch became vacant with the death of George W. Pritchett, which occurred Sept. 15. Mr. Pritchett had been manager of the Charlotte office since its opening and was well known throughout the South. Mr. Matthews has been assistant manager of the Charlotte office for the last eight years.

THE ATLAS ELEVATOR DEVICES COMPANY, 124 West 31st St., New York City, announces that it has entered into an agreement with the Evans Elevator Equalizer Company, Bedford, Ind., to represent that company in the New York territory. The Evans equalizer is a device for automatically equalizing the tension in elevator cables.

Fuel Prices

COAL

The following table shows the trend of the spot steam market in various coals, f.o.b. mines; mine run, except Pittsburgh gas slack:

Bituminous (Net Tons)	Market Quoting	Nov. 2 1927
Pool 1	New York	$2.35@$2.75
Smokeless	Boston	1.41
Clearfield	Boston	1.60@ 1.85
Somerset	Boston	1.75@ 1.90
Kanawha	Columbus	1.40@ 1.60
Hocking	Columbus	1.50@ 1.75
Pittsburgh	Pittsburgh	1.75@ 1.90
Pittsburgh gas slack	Pittsburgh	1.10@ 1.25
Franklin, Ill	Chicago	2.25@ 2.50
Central, Ill	Chicago	2.00@ 2.25
Ind. 4th Vein	Chicago	2.00@ 2.35
West Ky	Louisville	1.35@ 1.50
S. E. Ky	Louisville	1.40@ 1.75
Big Seam	Birmingham	1.65@ 2.00
Anthracite (Gross Tons)		
Buckwheat No. 1.	New York	2.90@ 3.25
Buckwheat No. 1.	Philadelphia	3.00@ 3.75
Birdseye	New York	1.60

FUEL OIL

New York—Nov. 10, light oil, tank-car lots, 26 deg. Baumé, 5c. per gal.; 28 deg., 5½c. per gal., f.o.b. Bayonne, N. J.

St. Louis — Oct. 31, tank-car lots, f.o.b. St. Louis, 24@26 deg., $1.55 per bbl.; 26@28 deg., $1.60 per bbl.; 28@30 deg., $1.65 per bbl.; 30@32 deg., $1.70 per bbl.; 32@36 deg., gas oil, 4.273c. per gal.; 38@40 deg., 5.23c. per gal.

Pittsburgh—Oct. 27, f.o.b. local refinery, 30@40 deg., fuel oil, 4¾c. per gal.

Philadelphia—Oct. 27, 26@30 deg., $1.60@$1.66 per bbl.; 13@19 deg., $1.56 @$1.62 per bbl.; 22 plus, $1.79@$1.85 per bbl.; 27@30, $2.10@$2.16 per bbl.

Cincinnati — Nov. 1, tank-car lots, f.o.b. local refinery, 24@26 deg. Baumé, 4.9c. per gal.; 26@30 deg., 5.15c. per gal.; 30@32 deg., 5½c. per gal.

Chicago—Nov. 5, tank-car lots, f.o.b. Oklahoma, freight to Chicago, 90c. per bbl.; 22@26 deg., 80@85c. per bbl.; 26@30 deg., 90c. per bbl.; 30@32 deg., $1.05 per bbl.

Boston—Nov. 7, tank-car lots, f.o.b. 12@14 deg. Baumé, 4.2c. per gal.; 28@ 32 deg., 5¾c. per gal.

Dallas—Nov. 5, f.o.b. local refinery, 26@30 deg., $1.45 per bbl.

THE LINCOLN ELECTRIC COMPANY announces the transfer of R. P. Nick from the Baltimore, Md., office to the Lancaster, Pa., office, where he will be in charge of the sale of "Linc-Weld" motors and "Stable-Arc" welders.

R. H. BEAUMONT COMPANY, Philadelphia, announces that George T. Birch, recently connected with the home office, has been transferred to the Detroit office, 901 Kresge Building, and will act as district manager of that territory.

Trade Catalogs

INDUCTION MOTORS — The General Electric Company in GEA-834 treats of CR7764-C1 controllers for A.-C. slip-ring induction motors, from 5 to 50 hp., 220, 440 and 550 volts, three-phase, 60 cycles.

VENTILATION—The Herman Nelson Corporation, Moline, Ill., has issued the fourth edition of the bulletin dealing with Univent ventilation system, which is a complete individual ventilating machine, for drawing fresh air directly from out-of-doors, cleaning it, warming it and delivering it without drafts.

BLOWDOWN SYSTEM — The Henszey De-Concentrator Company, D. H. Skeen & Company, general agents, 53 West Jackson Boulevard, Chicago. The operation of the Henszey De-Concentrator consists of withdrawing or blowing off the concentrated impure water from the boiler and substituting fresh water instead at the same time transferring all of the heat from this blowoff to the feed water. The device automatically operates at all times when cold makeup water, which means impurities, is being fed to the feed water heater.

UNIT HEATERS—RADIATOR SECTIONS.—The Herman Nelson Corporation, Moline, Ill., has devoted an illustrated catalog to the description of the Herman Nelson hiJet unit heater, guaranteed to withstand steam pressures from 1 to 150 lb. The wedge core radiator of this heater has no brazed, welded, soldered or expanded joints. It will withstand, it is claimed, continuous strain of expansion and contraction, as well as jars from steam or water hammer in the severest heating service without developing leaks. Designed for long-range air and heat delivery, this unit renders a straight smooth-flowing jet which assures an equalized heat diffusion. Another illustrated catalog of the Herman Nelson Corporation treats of radiator sections of the wedge core radiator for air warming, air cooling, air condensing, air drying, etc. Originally designed to meet the specific requirements in a heating element for the company's Univent system of ventilation, separate sections and headers are now being offered for general heating, cooling and condensing purposes.

SYNCHRONOUS MOTORS.—The Elliott Company has issued Bulletin "L" on synchronous motors. It is a 16-page bulletin printed in two colors. In addition to the descriptive text matter it contains numerous views showing the construction of Elliott synchronous motors and motors at work in the field, and there is also on the latter pages a discussion of the use of synchronous motors for power factor correction. Copies of the bulletin may be had from Elliott Company's district offices, or the main works at Jeannette, Pa., or the Ridgway Dynamo & Engine works at Ridgway, Pa.

NEW PLANT CONSTRUCTION

Ala., Gorgas — Alabama Power Co., T. W. Martin, Pres., 600 North 18th St., Birmingh .n, had plans prepared for the construction of first unit of steam electric power plant near here, initial capacity 50,000 kw., ultimate total capacity 200,000 kw. Initial cost $5,000,000. Ultimate total cost approximately $20,000,000.

Calif., Los Angeles—Embassy Hotel Co., c/o Bard & Co., Pacific National Bank Bldg., Contrs., awarded contract for a 13 story hotel at 6th and Loomis Sts. Estimated cost $600,000.

Calif., Richmond — Petroleum Securities Co., Petroleum Securities Bldg., Los Angeles, had plans prepared for the construction of a distribution plant. Estimated cost $2,000,000. Private plans.

Ill., Chicago — Beacon-Wilson Corp., awarded contract for the construction of a hotel including mechanical refrigeration plant, elevators, etc. at Wilson Ave. and Beacon St. to Paragon Construction Co., 228 North La Salle St. Estimated cost $685,698.

Ill., Chicago—Cramer & Foot 65 East 79th St., awarded contract for masonry, etc. for an 11 story bank and office building at 79th and State Sts. Estimated cost $750,000.

Ill., Chicago—Elm Street Building Corp., c/o W. Bernhard & Co., 820 Tower Court, Archts., is having plans prepared for an 18 story hotel including central refrigeration plant, elevators, etc. Estimated cost $1,500,000.

Ill., Chicago—G. E. Holmes, Lake St. and Wabash Ave., is having plans prepared for a 10 story stores building at Dearborn and West Lake Sts. Estimated cost $2,000,000. D. D. Meredith, 222 West Adams St., is architect.

Ill., Chicago—Owner, c/o Rissman & Hirschfeld, 222 North La Salle St., Archts., awarded contract for masonry, etc. for a hotel and stores building at Milwaukee and Kimball Aves. Estimated cost $800,000.

Ill., Chicago — Syndicate, c/o Rebori, Westworth, Dewey & McCormick, 332 South Michigan Ave., Archt., is having plans prepared for a 13 story apartment building at Banks and Astor Sts. Estimated cost $500,000.

Ill., Chicago—Three Hundred Seventy Sheridan Building Corp., awarded contract for the construction of a 17 story apartment building at Sheridan Rd. and Aldine Ave. to The Reliance Co., 11 South La Salle St. Estimated cost $2,000,000.

Ia., Marshalltown—Eppley Hotels Co., E. C. Eppley, Pres., Hotel Fontenel, Omaha, Neb., is having preliminary plans prepared for a 7 story hotel including steam heating system, etc. Estimated cost $750,000. Private plans.

Ky., Louisville—Bd. of Education, plans the construction of a school including steam heating system, etc. at 40th and Herman Sts. Estimated cost $800,000. J. Meyrick Cooley, c/o owner, is architect.

La., New Orleans—Presbyterian Hospital, Carondelet St., awarded contract for a 5 story medical building to T. H. Brockman, Hibernian Bldg. Estimated cost $700,000. Steam heating, ventilation and refrigeration systems, boilers, elevators, etc. will be installed.

Me., Lewiston — Androscoggin Electric Co. awarded contract for the construction of a power house to Morton C. Tuttle, 862 Park Sq. Bldg., Boston, Mass.

Mass., Boston—The Durant Inc., F. B. Chuld, Chn., Building Committee, 336 Huntington Ave., is having preliminary plans prepared for a 14 story hotel and club building. Coolidge & Carlson, 89 State St., Boston, are architects.

Mass., Boston—Woodstock Trust, c/o H. F. Kellogg, 378 Stuart St., awarded contract for a 14 story office building at 89 Broad St. to Turner Construction Co., 178 Tremont St.

Mass., Brighton (Boston P. O.)—Schoolhouse Dept., City Hall, Boston, is having plans prepared for a high school here. Estimated cost $1,539,000. O'Connell & Shaw, 134 Newbury St., Boston, are architects.

Mass., Everett (Boston P. O.)—Malden Electric Co., 139 Pleasant St., Malden, is receiving bids for the construction of an electric sub-station on Thorndike St. here. Estimated cost $50,000. C. H. Tenney Co., 200 Devonshire St., Boston, is engineer.

Mass., Somerville (Boston P. O.)—City, L. M. Conwell, City Hall, Mayor, will receive bids until Nov. 23 (extended date) for addition to high school including central heating plant. Estimated cost $1,250,000. F. I. Cooper Corp., 172 Tremont St., Boston, is architect.

Mass., Waltham (Boston P. O.)—Dept. of Mental Diseases, W. A. Merrill, Bus. Agt., Boston, will receive bids until Nov. 25 for the construction of a group of hospital buildings on Trapelo Rd. at junction of town lines of Waltham, Lexington and Belmont. Estimated cost $4,000,000. G. Robb, 14 Beacon St., Boston, is architect.

Mich., Ann Arbor—Lawrence A. Snell, c/o L. Kamper, 3729 Cass Ave., Detroit, Archt., awarded contract for a 4 story hotel on Division St. to Everett Winters, 1651 East Grand Blvd., Detroit. Estimated cost $500,000. Steam heating, refrigeration and ventilation systems, boilers, elevators, etc. will be installed.

Mich., Detroit—Chevrolet Motor Corp., West Grand Blvd., awarded contract for addition to power plant to Martin Krausssman Co., 955 East Jefferson Ave.

Mich., Grand Rapids—Turner & Thebaud, Archts., are receiving bids for the construction of a power plant for American Laundry Co. Estimated cost $125,000

Miss., Clarksdale — Yazoo-Mississippi Delta Levee Board, will soon receive bids for the construction of a pumping plant for drainage system at McKinley Lake. Estimated cost $46,000. W. L. Head, is chief engineer.

Miss., McComb—X. A. Kramer, plans the construction of 7 story hotel. Estimated cost $500,000. C. H. Lindsley, Jackson, is architect.

Miss., Vicksburg—A. H. Alvis, Jackson, plans the construction of a hotel here. Estimated cost $500,000. N. W. Overstreet, Jackson, is architect.

Mo., Bridgeton—City, A. B. Lambert, 457 North Kingshighway Blvd., is having pre-

liminary plans prepared for the construction of an airport including power plant, etc. Estimated cost $800,000.

Mo., Cabool—City plans an election Nov. 15 to vote $49,000 bonds for waterworks improvements including 100,000 gal. reservoir, deep well pumping equipment, 60,000 gal. tank on tower, mains, etc. A. H. Kendricks, Seymour, is engineer.

Mo., Hamilton—City plans an election Nov. 22 to vote $30,000 bonds for waterworks improvements including pumping unit, mains, etc. Burns & McDonnell Engineering Co., 402 Interstate Bldg., Kansas City, Mo., are engineers.

Mo., St. Louis—N. Frank, Arcade Bldg., has acquired a site and plans the construction of a 20 story hotel including steam heating system, etc. at Chestnut and Nineteenth and Twentieth Sts. Estimated cost $2,000,000.

Mo., St. Louis—Polar Wave Ice & Fuel Co., 3638 Olive St., awarded contract for the construction of an ice plant at 6801 Arsenal St., to Woermann Construction Co., 1441 Syndicate Trust Bldg. Estimated cost $60,000.

Mo., St. Louis—Versailles Building Co., c/o Willson & Koontz Realty Co., 18 North 8th St., will build a 10 story apartment including steam heating system, etc. at Skinker and Rosebury Sts. Estimated cost $1,200,000. Work will be done under separate contracts under the supervision of Edward Wagner of Willson & Koontz Realty Co.

Neb., Harvard—City plans an election soon to vote $49,000 bonds for the construction of an electric light plant including Diesel engines, etc. Grant, Fulton & Letton, 525 South 13th St., Lincoln, are engineers.

Neb., Omaha—Kitchen Hotel Co., plans the construction of a 12 story hotel at 14th and Tusman Sts. Estimated cost $2,000,000. L. Daly, Peters Trust Bldg., is architect.

N. Y., New York—Bd. of Transportation awarded contract for the construction of buildings and shops at 207th St. yards, to Eastern Construction Co., 110 West 40th St. $4,170,000.

N. Y., New York—Bd. of Trustees, Bellevue & Allied Hospitals, C. A. Perilli, Acting Pres., 415 East 26th St., awarded contract for an out-patient department and dormitory at Bellevue Hospital, 26th St. and First Ave. to Kenny Bros., 33 Old Broadway. $1,239,000.

N. Y., New York—Dept. of Welfare, B. S. Coler, Comr., Municipal Bldg., awarded contract for the construction of a power house, etc. for Lincoln Hospital at Colcord Ave. and East 141st. St. to W. W. Construction Co., 15 West 40th St.

N. Y., New York—J. M. Felson, 250 West 57th St., Archt., will receive bids about Jan. 1 for a 15 story apartment building for Forty West Seventy Seventh St. Corp., c/o architect. Estimated cost $1,400,000

N. Y., New York—A. E. Lefcourt, 1351 Broadway, is having preliminary plans prepared for a 42 story office building at 5th Ave. and 43rd St. Estimated cost $11,000,000. Architect not selected.

N. Y., New York—Wall-Hanover St. Realty Co., c/o Starrett Bros., 191 Park Ave., Contrs., awarded contract for a 35 story office building at Wall, Hanover and Beaver Sts. Estimated cost $3,000,000. Delano & Aldrich, 126 East 38th St., are architects.

O., Akron—Bd. of Trustees, City Hospital, will soon award contract for an 8 story addition to hospital including steam heating system, etc. on East Market St. Estimated cost $800,000.

Okla., North Miami (mail Miami)—City, I. O. Stevens, Clk., will soon award contract for waterworks improvements including triplex pump and motor, etc. Estimated cost $15,000.

Ore., Portland—U. S. Veterans' Bureau, Arlington Bldg., Washington, D. C., will receive bids until Dec. 29 for the construction of an ice making and refrigeration plant, etc., for U. S. Veterans' Hospital, here.

R. I., Providence — New York, New Haven & Hartford R.R. Co., New Haven, Conn., is receiving bids for the construction of a terminal on Harris Ave., here. Estimated cost $625,000. E. Gagel is chief engineer. Providence Fruit & Produce Exchange is lessee.

Texas—Texas Power Corp., c/o F. H. Willmot, Pres., Sequin, awarded contract for the construction of two hydro-electric plants 6 and 7 and dams on the Guadelupe River, including power houses, etc., 3,000 kw. daily capacity near San Antonio between Sequin and Gonzales to Sumner Sollitt Co., National Bank of Commerce Bldg., San Antonio. Estimated cost $2,000,000. Plant 4, near Sequin, is contemplated for the near future.

Tex., Amarillo — Atchison, Topeka & Santa Fe R.R., 80 East Jackson Blvd., Chicago, Ill., will soon receive bids for the construction of an office building here. Estimated cost $750,000. C. F. Felt, is chief engineer.

Tex., Beaumont—E. G. Edson, c/o Edson Realty Co., is having plans prepared for a 14 story hotel including steam heating, refrigeration and ventilation systems, boilers elevators, etc. at Pearl and Liberty Sts. Estimated cost $1,500,000. F. W. Steinman, 411 San Jacinto Life Bldg., is architect.

Tex., Del Rio—Illinois Pipe Line Co. will build and equip ten electrically-driven oil pumping power stations, 400 hp. each for driving the flow of oil in the main pipe line from Yate fields at Val Verde county to Tidewater. Power to be furnished by the Central Power & Light Co. Estimated cost $250,000. Private plans.

Tex., Del Rio—Central Power & Light Co., c/o E. B. Neiswanger, Frost Bldg., San Antonio, will soon award contract for the construction of a hydro-electric power plant and dam on Devils River near here. Plans include one large dam and several smaller ones to furnish water for irrigation projects in Winter Garden district, and also power for towns in the district. Estimated cost $500,000. Private plans.

Tex., Devine—City will soon award contract for waterworks improvements including pumping plant, deep well pump, 200 g.p.m. motor driven centrifugal service pump, one 500 g.p.m. motor driven fire pump, etc. Estimated cost $28,000. Walton & Arneson, 418 Gunter Bldg., San Antonio, are engineers.

Tex., San Angelo—San Angelo Ice Co., c/o M. D. Kennemer, is having plans prepared for a 40 ton addition to ice plant to double present capacity. Estimated cost $75,000. Private plans.

Wash., Seattle — City Council passed ordinance providing for the construction of a dam at Hanging Rock above Diablo Canyon in connection with municipal hydro-electric development. Estimated cost $2,000,000.

Wash., Wenatchee—The Great Northern Ry. Co., St. Paul, Minn., plans the construction of a sub-station, also housing a 7,500 kva. frequency changer set in connection with electrification of 96 miles of railway from Gold Bar to Wenatchee. Power to be furnished by Puget Sound Power & Light Co. Estimated cost $200,000. J. R. W. Davis is chief engineer.

Wash., Wenatchee—Puget Sound Power & Light Co. plans the construction of a sub-station. Estimated cost $100,000.

Equipment Wanted

Boiler — Supersilk Hosiery Mills, G. Thompson, Mgr., London, Ont., plans to purchase a steam boiler for proposed factory. Estimated cost $75,000.

Boiler and Turbo-Generator — A. A. Langewald Jr., 86 Essex St., Boston, Mass., is in the market for a 600 hp. Massachusetts Standard 200 lb. boiler and a 300 kw. turbo generator, 3 ph., 60 cycle, 600 v., a.c. 200-75 lb. exhaust.

Boilers, Pumps, Compressors, etc.—Empire Refineries Co., Bartlesville, Okla., plans to purchase boilers, pumps, compressors, etc., for prfoposed extensions and improvements to refinery at Ponca City, Okla. Estimated cost $850,000.

Electrical Machinery — Bd. of Public Works, Seattle, Wash., will receive bids until Dec. 2, for the installation of electrical machinery including 14,285 kva. generator with reaction type turbine, transformers, switches, exciter, etc. in unit No. 6 of Cedar Falls hydro-electric development. Estimated cost $200,000.

Engines and Cooling System — Inland Utilities Co., Perryton, Tex., subsidiary of Fairbanks-Morse Co., 1218 Liberty St., Kansas City, Mo., plans the installation of engines, also cooling system for electric light and power plant at Perryton, Tex. Estimated cost $60,000.

Hoist—Modern Coal & Material Co., 154 West Lafayette Ave., St. Louis, Mo., plans to purchase a 40 to 50 hp. gasoline hoist, with two 14 in. drums.

Ice Machine and Motor—City of Weleetka, Okla., plans to purchase a 15 ton ice machine and 15 hp. motor for proposed ice plant.

Pump—U. S. Veterans Bureau, Arlington Bldg., Washington, D. C., rejected bids of Oct. 11 for furnishing and installing a deep well pump, etc. in U. S. Veterans Hospital, Bedford, Mass.

Pump and Motor—City of Gotebo, Okla., will be in the market for a triplex pump and motor, for proposed waterworks improvements. Estimated cost $24,000.

Pump, Motor, etc. — Borough Council, Borough Hall, Florham Park, N. J., will receive bids until Nov. 21 for pump, motor, etc., for proposed deep well and pumping station.

Pumping Equipment, etc.—Sanitary District of Chicago, M. J. O'Brien, Clk., 910 South Michigan Ave., Chicago, Ill., will receive bids until Dec. 1 for the installation of pumping equipment and auxiliary and mechanical electrical equipment for proposed sewage pumping station.

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